The Operation, Care, and Repair of Farm Machinery

THE OPERATION, CARE, AND REPAIR OF FARM MACHINERY

TWENTY-FIFTH EDITION

THIS BOOK IS THE PROPERTY OF

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MANUFACTURER OF QUALITY FARM EQUIPMENT

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THE OPERATION, CARE, AND REPAIR OF FARM MACHINERY

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CONTENTS

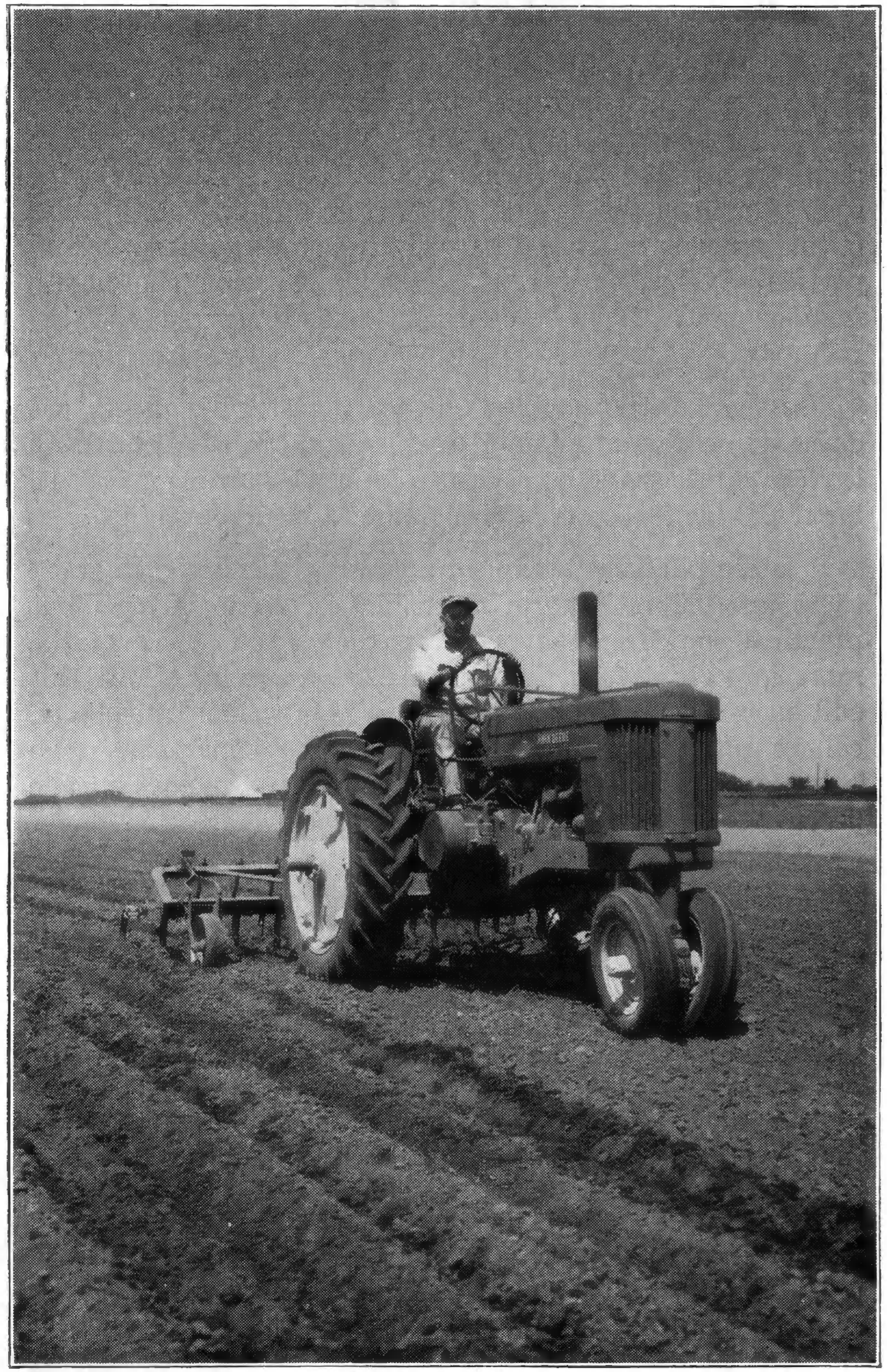
PREFACE

MECHANIZATION of the farm during the last twenty years has increased by leaps and bounds. Today, for example, there are approximately 3 million more tractors on the farm than in 1930. Naturally with such growth in the number of tractors and obviously other farm implements, it is essential that today's farmer and particularly the farmer of tomorrow become thoroughly familiar with farm mechanics and improved farming methods.

Throughout the country, high schools and colleges are doing an outstanding job of teaching tomorrow's agriculture leaders. Their work is certain to improve farming methods, lower production costs, and increase farm productivity.

It is the publisher's aim, in preparing this book, to assist these instructors in farm mechanics in giving a brief but practical course in the operation, care, and repair of the more important farm implements. Any success which this edition may enjoy is due largely to high school instructors, college professors, and state agriculture supervisors who have given appreciated assistance and suggestions in the preparation of this and previous editions.

JOHN DEERE



PART ONE

POWER ON THE FARM

Mechanical power made its first appearance on the American farm late in the nineteenth century. To be sure, power in the form of steam traction engines, used primarily for operating the threshing rig, was in use; yet the first real trend to farm-owned power began about the time of the Spanish-American War. It gained great impetus from that time, principally on the larger farms where the standard-type tractor was used for field work such as plowing, disking, seeding, and harvesting.

With the advent of the general-purpose tractor, the trend was, decidedly, toward power farming. With his general-purpose tractor, the farmer had power adaptable to all his farm jobs. The constant improvement of the general-purpose tractor and its ever-broadening adaptability have made tractors of this type the most widely used power on farms today.

Figure 1—This general-purpose tractor is pulling a three-bottom plow controlled by hydraulic power through the remote cylinder.

It is due, largely, to the improvement of the general-purpose tractor that the tractor is the principal source of power on most farms throughout the Nation. It has aided materially in cutting production costs, increasing the working capacity of the farm worker, and speeding up farm operations. The remarkable increase in the number of tractors on farms in the past is an indication of what may be expected in the future as tractors and tractor-operated machines are developed to an even higher state of efficiency and practicability for farms of all sizes.

The general-purpose tractor of today, built in a wide variety of styles, sizes, and power capacities, provides the farmer with power for all farm jobs—plowing, disking, planting, cultivating, mowing, and all other major operations, including belt work.

Recent years also have brought a better and more general knowledge among farmers of the factors that govern the

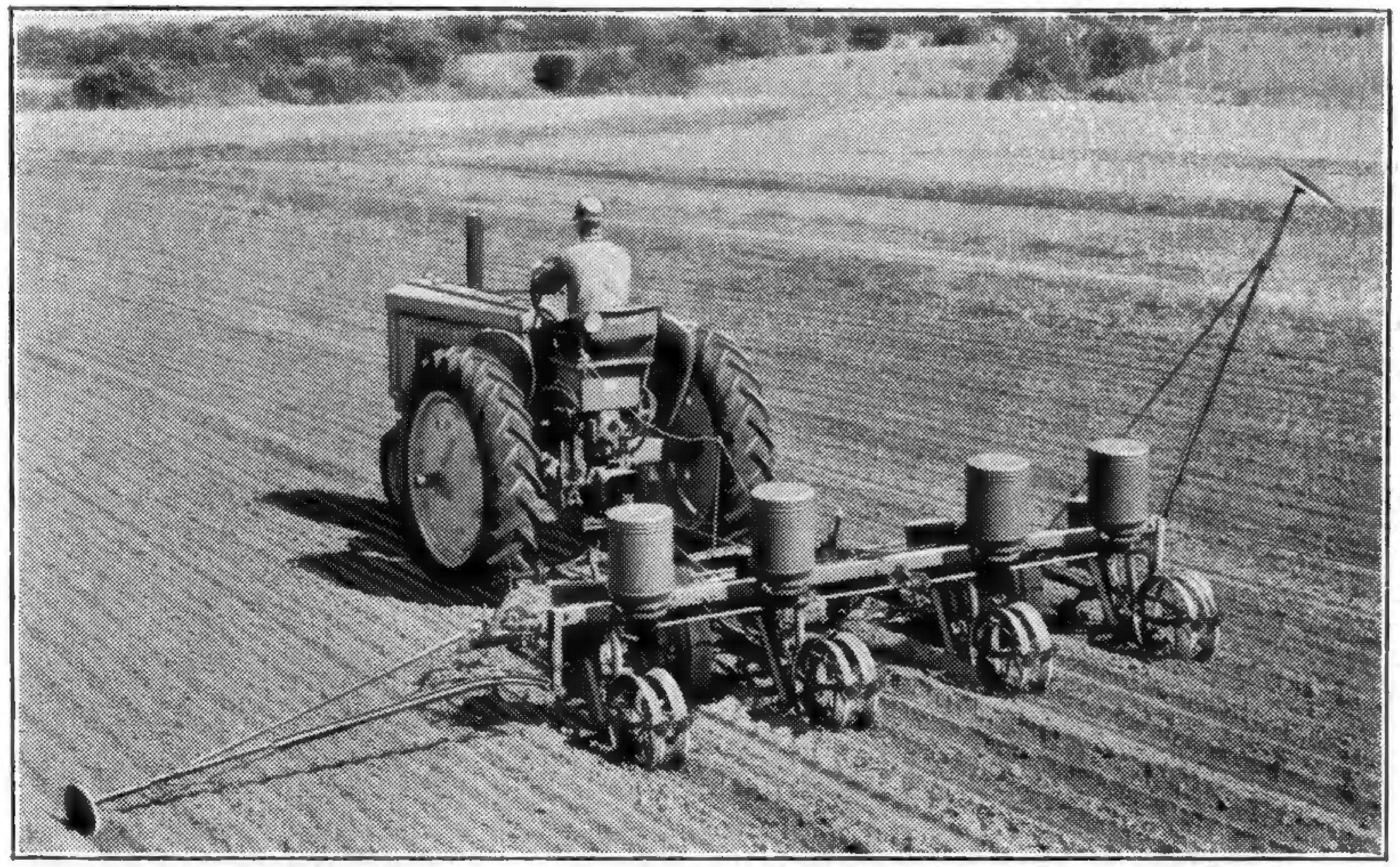


Figure 2—General-purpose tractor and high-speed corn planter planting four rows of corn.

operation and care of internal-combustion engines. This factor, combined with the great improvement in tractor design, has resulted in more satisfactory performance of farm power units and less expense for repairs and service.

Modern farm tractors may be divided into three general classes: the general-purpose type, the standard type, and the track type.

Chapter I.—TRACTORS

GENERAL-PURPOSE TRACTORS

The general-purpose type of tractor, as its name implies, furnishes power for practically all farm work. Not only does it perform all the drawbar, belt, and power shaft jobs but, with the wide variety of integral equipment available for it, the general-purpose tractor puts speed and economy into many jobs for which the standard- or track-type tractor cannot be adapted, such as the cultivating of row-crops.

Figure 3—Cultivating corn with an integral two-row tractor cultivator.

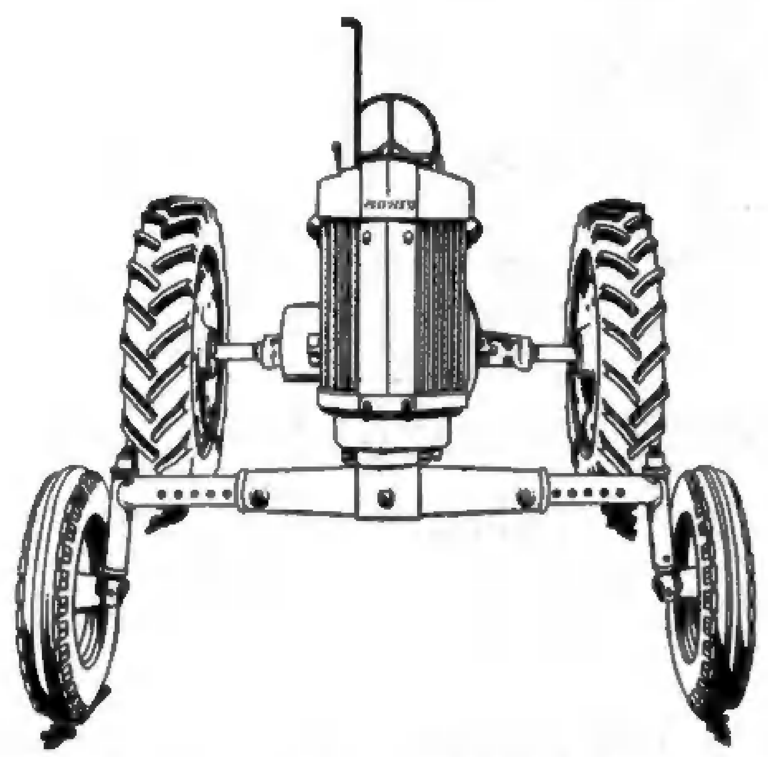


Figure 4—General-purpose tractor with adjustable front wheels; interchangeable with single front wheel, right.

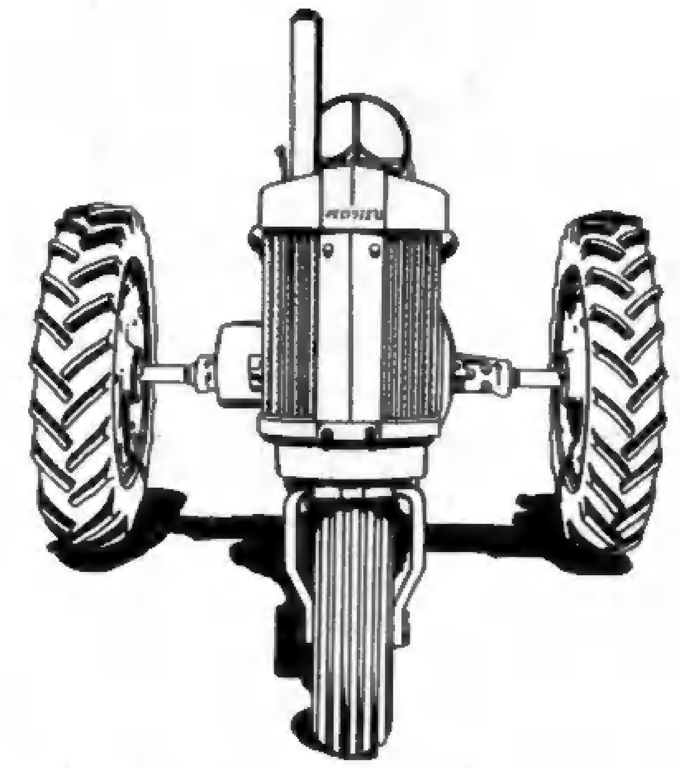


Figure 5—General-purpose tractor with single front wheel.

Taking into account the size of farms, the nature and relative importance of the various jobs to be done, manufacturers of present-day tractors aim to meet the need of every farm both in the matter of power required and type of equipment to be used for the crops to be grown. As a result, there is today a wide range of power sizes and types of general-purpose tractors to meet practically all requirements.

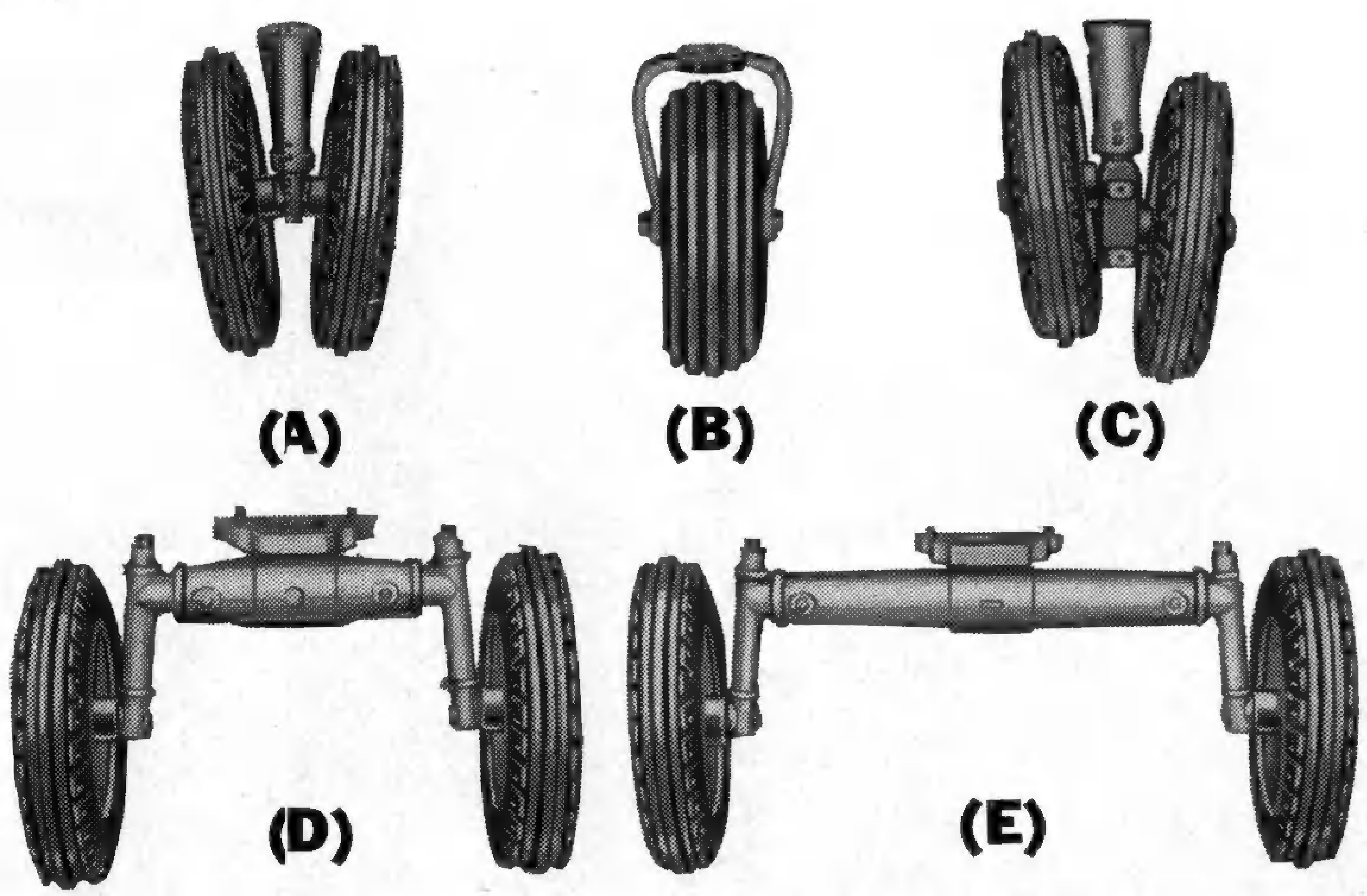


Figure 6—Some general-purpose tractors have two-piece front pedestals which permit the use of any of these front wheel assemblies: (A) dual front wheels; (B) single front wheel; (C) load equalizer wheels; (D) fixed 38-inch wheels; (E) adjustable front wheels.

The conventional general-purpose tractor, Figs. 3 and 7, has two rear-drive wheels and a front steering member such as the regular dual front wheels or dual wheels equipped with the load equalizer. (See Fig. 10.) This basic design has many variations for specialized farm work.

For example, the tractor shown in Fig. 4, is equipped with the adjustable front axle for straddling wide beds, plowing, or working in extremely soft ground conditions. Wheels can be set in different positions to meet varying conditions. Oftentimes this front axle can be interchanged with a single front wheel (Fig. 5) which is essential for good work in narrow-spaced row crops.

Some conventional general-purpose tractors have special 2-piece front pedestals which permit interchanging the dual front wheels, used in general row-crop work, with any of the assemblies shown in Fig. 6. These include the load equalizer wheels; single front wheel; the fixed 38-inch tread front end, designed for bedder equipment; and the adjustable front axle, mentioned previously.

Figure 7—The small tricycle-type, general-purpose tractor is ideal for cultivating.

Sizes of general-purpose tractors vary from small tricycle type or four-wheel type, as shown in Figs 7 and 8, to big-capacity, 3-plow tractors. The small horsepower models are designed to bring all the advantages of power farming to the small-acreage farmer or to serve as auxiliary or "helper" power on the larger farms. A complete line of integral equipment, easily attached and detached, and controlled by the hydraulic power control system, is generally available for tractors of this type.

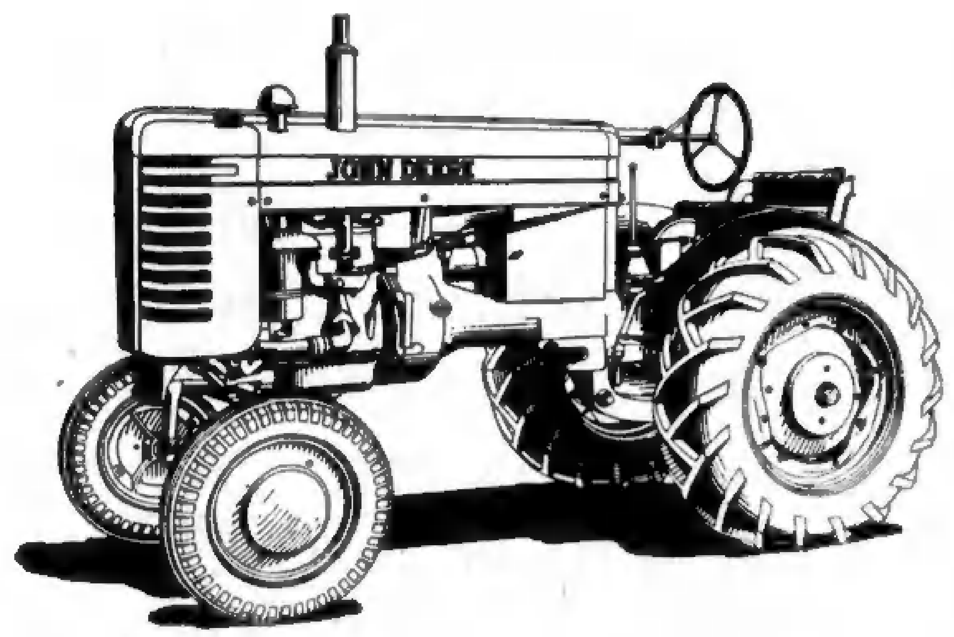


Figure 8—The small general-purpose tractor of the four-wheel type.

In heavier soils and on large-acreage farms where row crops are raised, the general-purpose tractor of three-plow power meets the power requirements of most farmers. It is fully adaptable to the varied farm operations including plowing, planting, cultivating, and harvesting, plus work requiring belt power.

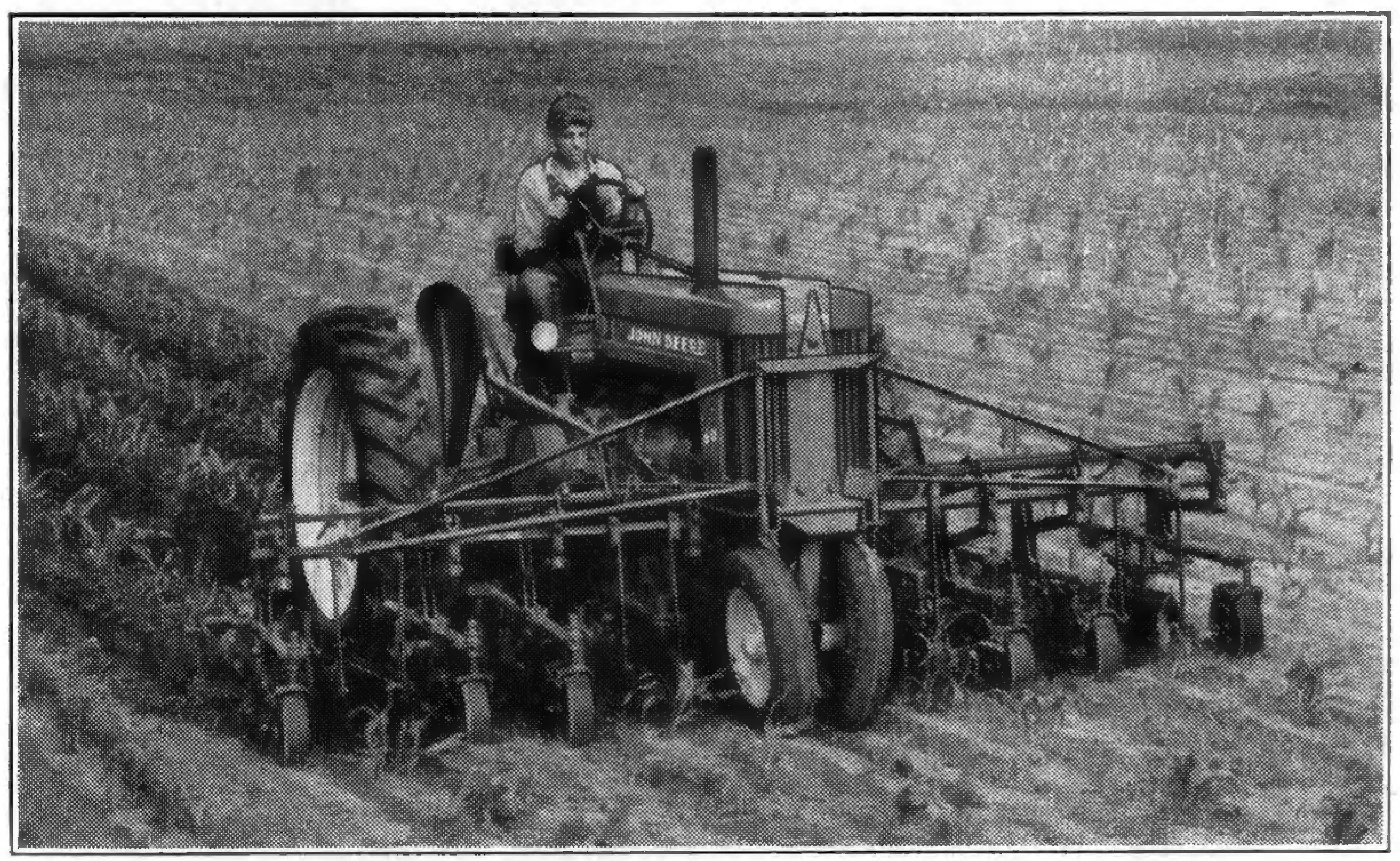


Figure 9—Cultivating corn four rows at a time with an adjustable-tread tractor.

Weight Is Factor. A general-purpose tractor must be heavy enough to give good traction efficiency in plowing and similar heavy work, yet no heavier than needed, because a larger part of its work is on mellow soil. Weight must be properly distributed to gain efficient traction and to maintain stability. The engine must have enough power for the heavier drawbar jobs, yet be efficient at lighter loads. The clearance of all parts that pass above cultivated plants must be sufficient to allow the tractor to pass over them without harming them, yet the machine must not be top-heavy.

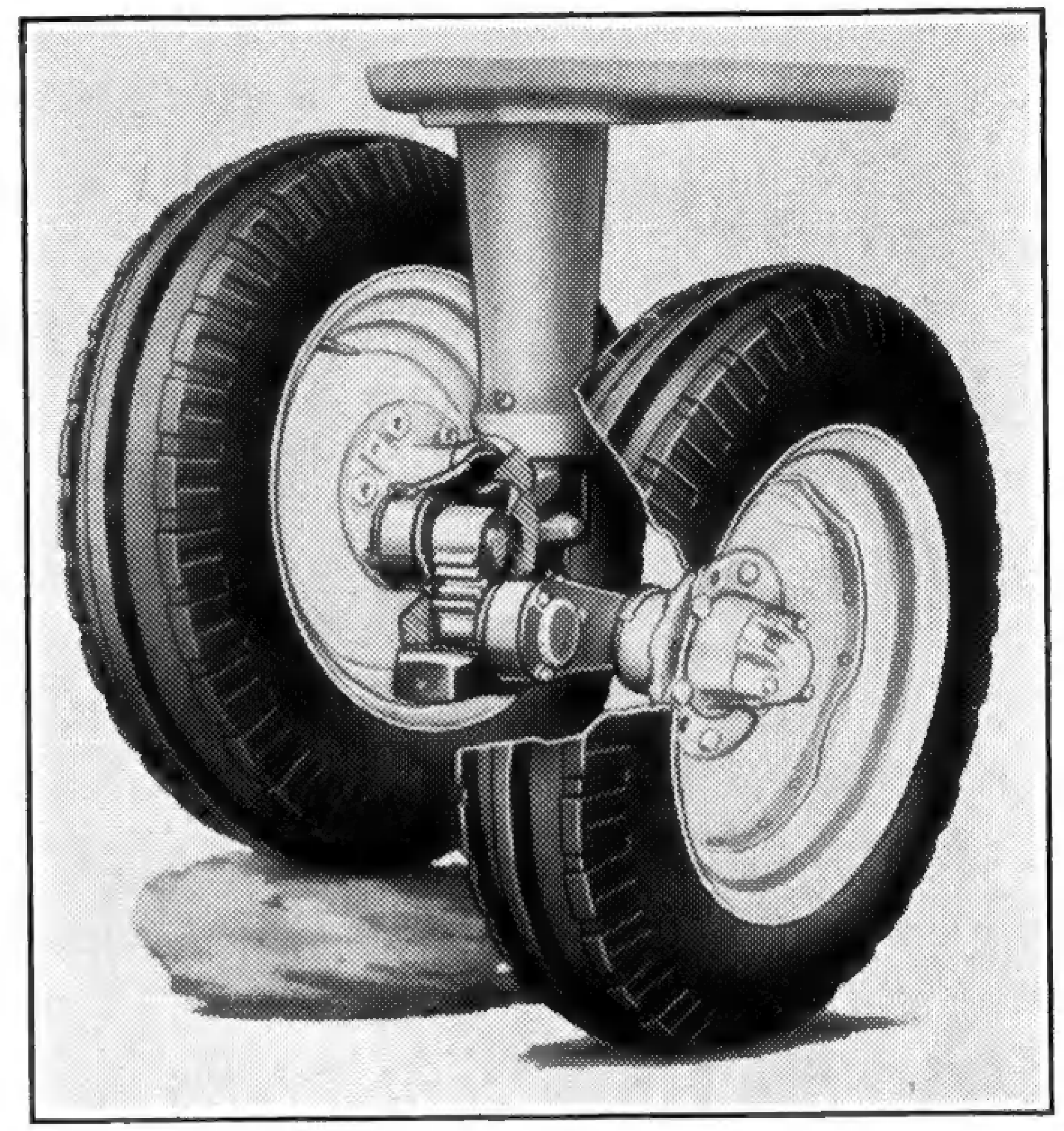


Figure 10—The front wheel load equalizer is shown here in X-ray view to show differential construction.

A typical general-purpose tractor, with adjustable rear-wheel tread, which can be equipped for a wide variety of uses in almost any row crop, is illustrated in Fig. 21. Two- and four-row planters, two- and four-row cultivators for corn, cotton, and other crops, multi-row cultivators for special row crops, and two-, three-, and four-row bedders for cotton are some of the equipment that can be used with this tractor. For such jobs as plowing, the rear wheels can be set in 56-inch tread, which largely overcomes side draft. Fig. 9 shows the four-row cultivating unit attached to the adjustable tread tractor.

Some modern tractors have means for quickly changing the rear-wheel tread. The general-purpose tractor men-

tioned previously has wheels which are adjustable from 56 to 88 inches. (See Figs. 11 and 12.) The wheel is jacked up three clamp screws which hold the wheel in position are loosened, two jack screws are tightened to free the wheel on the axle, and the adjusting nut is turned to move the wheel in or out. The operation is reversed to relock the wheel in any spacing setting desired.

Manufacturers of tractors and farm equipment now provide a wide variety of equipment for their tractors, making it possible to grow and harvest practically any crop, using tractor power exclusively. The attachments and machines available are so numerous as to make impractical a complete consideration of them in this text. The implement dealer's store provides the best place to see and study the various equipment available for each community.

Clearance Important. The general-purpose type tractor must be so constructed as to allow all necessary clearance above the growing crops. Ample clearance is gained in the

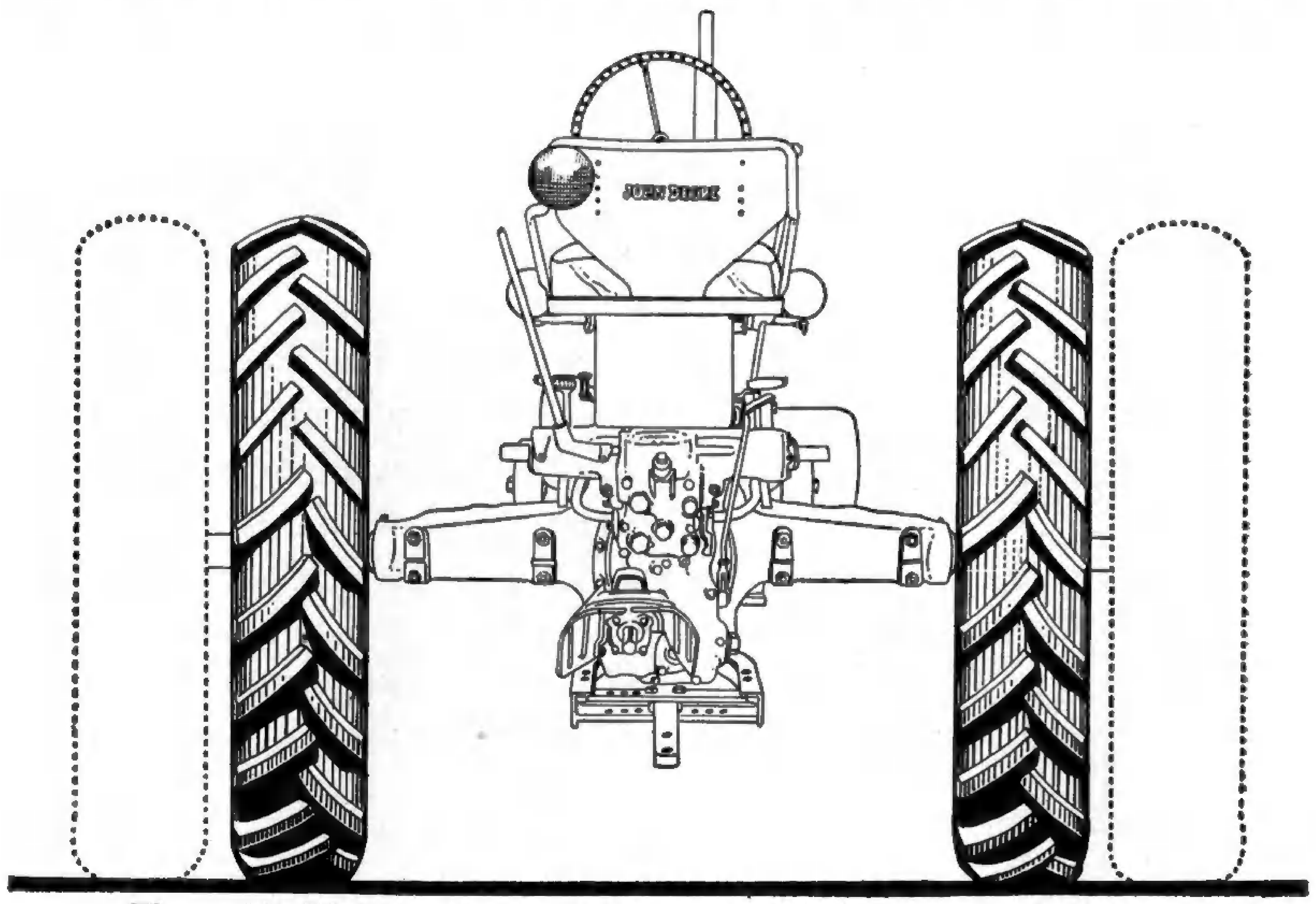


Figure 11—Diagram showing maximum variation in rear wheel tread.

adjustable-tread, general-purpose tractor by several important features of construction. By mounting the front of the tractor on a single support and extending rear wheel tread to straddle two rows, the engine is placed between the rows. In addition, the high drive wheels, in combination with the properly designed rear axle housing, provide ample clearance for cultivating practically all row crops.

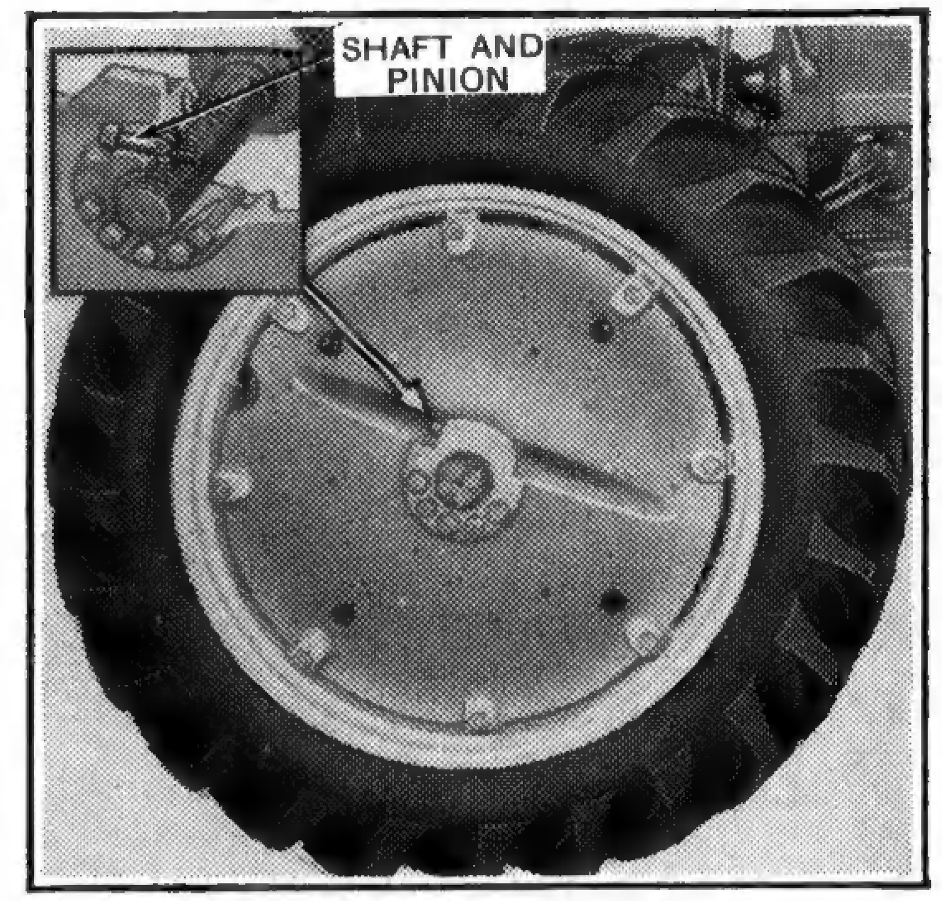


Figure 12—Quick change of the tread of the rear wheel is a modern convenience row-crop farmers need.

It is highly desirable in planting and cultivating to turn completely around without stopping and be in position to continue back on the next set of rows. To make this possible, there is a separate brake for each rear wheel on the general-purpose tractor shown. Pressing the brake pedal for the inner wheel holds the wheel back and aids the front wheels in swinging the tractor around sharply.

High-Crop or High-Clearance Tractors. In some sections of the country, extremely tall, bushy, and, sometimes, fragile crops are grown. These include such specialized crops as tomatoes and sugar cane which require maximum tractor clearance.

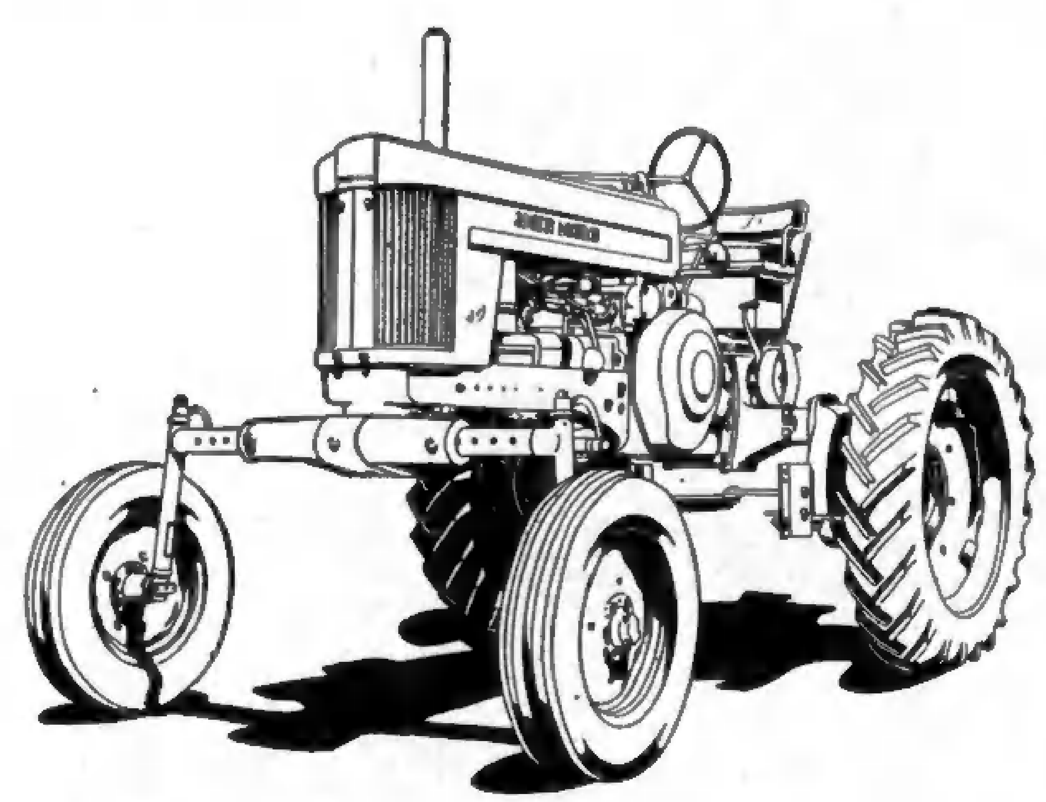


Figure 13—The general-purpose tractor of the high-crop or high-clearance type.

The answer to this need for extra clearance is found in the high-crop or high-clearance tractor. (See Fig. 13.) Normally this tractor is the same design

as the regular general-purpose tractor except for the added clearance. Thus, growers of tall crops can get extra, damage-free cultivations that help produce better yields and bigger profits.

Forward Speeds. In a general-purpose tractor, flexibility of speed has much to do with capacity and efficiency. In cultivating or transplanting, especially, there are times when it is necessary to go very slow. At other times, both speed and effectiveness are gained by traveling fast and throwing the soil briskly.

To meet this wide range of speed requirements, most general-purpose tractors have several forward speeds in the transmission gears, providing extremely slow speeds for certain field jobs as mentioned previously and higher speeds for transporting equipment on highways from barnyard to fields and return. These several forward speeds are provided so that the tractor can be operated at full throttle at all times, thereby assuring maximum engine efficiency.

Figure 14—Cultivating and fertilizing with a general-purpose tractor.

The power take-off device, which supplies power directly by shaft to machines being pulled by the tractor, has found wide application and great usefulness on tractors of both the standard and the general-purpose types. It is discussed in detail on page 47.

Care Important. It is very important that the tractor be given proper care. If the owner is dependent upon his tractor for all farm jobs, delays are costly. Careful handling, strict attention to oiling, adjusting and repairing the tractor and the equipment that is used with it, as directed by the manufacturer in the Operator's Manual, will result in greater satisfaction and greater net profits.

STANDARD-TYPE TRACTORS

While the general-purpose tractor, described in preceding pages, meets the needs of the row-crop farmer in plowing, planting, cultivating, and harvesting his crops, the particular power requirements of the small-grain grower and the orchardist are best met by tractors of standard design, especially adapted to the work at hand. On larger farms, where row crops are grown, standard-type tractors are often used to supplement the general-purpose tractors in preparing seedbeds and harvesting the crops.

What has been said about the design and care of the general-purpose tractor applies so generally to the standard types that a further discussion is unnecessary.

The standard-type tractor, furnishing power at three outlets, the drawbar, belt, and power take-off, is used for practically all power requirements except planting and cultivating. Many standard-type tractors are equipped with hydraulic systems for raising, lowering, or adjusting drawn equipment through a remote cylinder.

The tractor, shown in Fig. 15, is a typical two-three-plow tractor of this type. For larger farms, standard-type tractors having three-four-plow or more power are also in use.

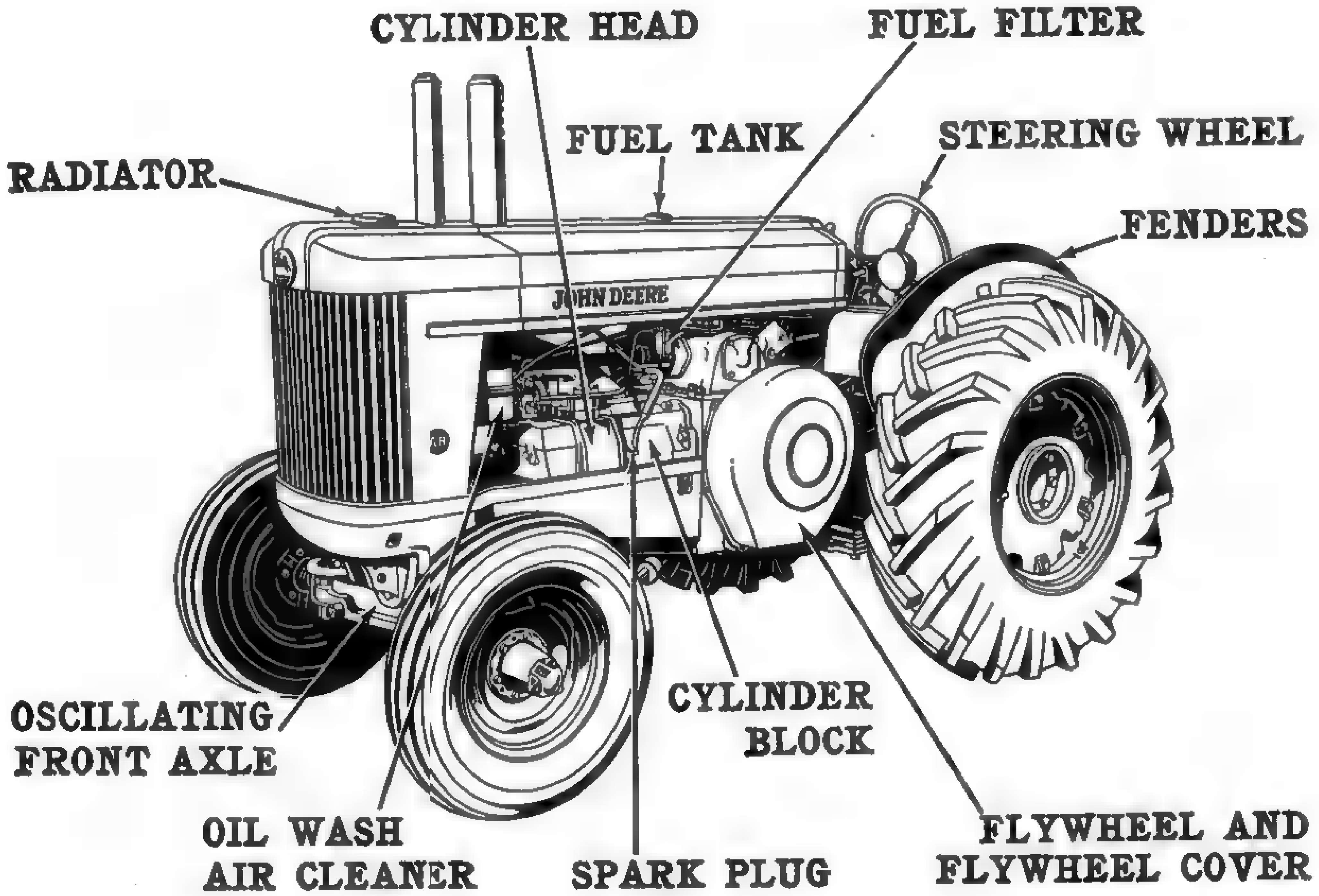


Figure 15—Standard-type tractor of two-three-plow power.

A further variation of this type is the orchard tractor. It is built low and compact with wheels and pulley shielded for working close to trees and under low-hanging limbs in orchards or groves (see Fig. 16).

On large-acreage farms where greater power is required for heavy-duty plowing, disking, seeding, and harvesting operations, the wheel-type Diesel tractor has increased in popularity during recent years. (See Fig. 17.) Fuel oils for Diesel tractors usually cost less, making Diesels far more economical to use on big-capacity farming jobs.

Figure 16—An orchard-type tractor working in a California orchard.

Track-Type Tractors. In extreme farming conditions, track-type tractors offer several definite advantages. These tractors have the flotation necessary for working in light soils, loose soils, rough terrain, in woodlands, etc., and they have the stability that is essential for working on extreme hillsides.

Track-type tractors vary in size, depending on the farming requirements. Typical of the smaller tractors of this type is that shown in Fig. 18. The traction mechanism of this tractor is essentially two endless, metal-linked belts or chains known as tracks. Each runs on two steel wheels, one of which is a sprocket wheel and acts as the drive; the other serves as an idler. Steering is accomplished through the tracks themselves by reducing the movement of one track below that of the other. Track rollers on the underside of the track frame act as supports for the machine and that part of the track in contact with the ground.

Figure 17—The wheel-type Diesel tractor of four-five-plow power.

Track-type tractors are used extensively in orchard work, for farming operations on extremely hilly sections and in light soils, for terracing, land clearing, and, particularly, for earth-moving and leveling operations in irrigated sections.

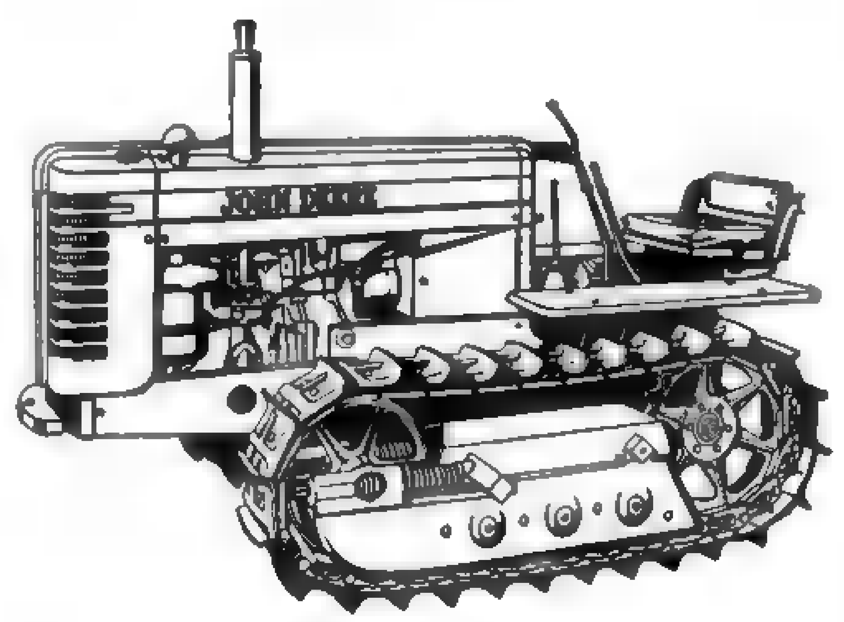


Figure 18—The track-type tractor of two-three-plow power.

Questions

1. *Name and describe the different types of tractors.*
2. *What are some of the advantages of the general-purpose tractor?*
3. *Why is weight an important factor in the general-purpose type tractor?*
4. *What is meant by a high-clearance tractor and where is it used?*

5. *What is the main difference in construction between the general-purpose tractor and the standard-type tractor?*
6. *What are the important advantages of the standard-type tractor?*
7. *Name the different types of standard-type tractors and describe their particular uses.*
8. *What is a track-type tractor and where is it used?*
9. *How is a track-type tractor controlled?*
10. *What types of tractors are best suited for the farming in your community?*

TRACTOR FUNDAMENTALS

All farm tractors, regardless of their size, type (general-purpose, standard, or crawler types), or kind of engine (Spark ignition or Diesel), are made up of four basic and fundamental units.

The heavy-duty Diesel tractor pulling a big-capacity offset disk harrow.

These include (1) the engine which is the source of power; (2) the transmission which makes this power available at the drawbar, power take-off, power lift, belt pulley, and which provides means for varying the forward speed to meet the job at hand and the condition encountered; (3) final drive (including the differential) which delivers the power from engine through transmission to the rear wheels; (4) clutch which acts as a coupling to connect the engine to the transmission and belt pulley. The efficiency of a tractor depends upon the proper functioning of all units—a condition which exists only when all units are properly adjusted and maintained.

Before attempting to operate a tractor or engine, the operator should make a careful and thorough study of the instruction book furnished by the manufacturer.

Although general engine principles are the same, each make of tractor or engine will have different operating procedures. The basic principles, common to practically

Figure 19—Keeping a tractor in good working condition makes the job easier for the tractor operator.

all internal-combustion engines used on the farm, will be discussed in the following pages.

Internal-Combustion Engines. An internal-combustion engine is an engine in which the heat or pressure energy necessary to produce motion is developed in the engine cylinder, as by the burning of a gas, and not in a separate chamber as in a steam engine boiler.

The fuel, mixed with air, ignites, burns rapidly, expands inside the cylinder, pushes the piston back, turns the crankshaft, and so develops power. The power generated can be applied to the operation of machines through the belt pulley in the case of the engine, and through the belt pulley, drawbar, power take-off and, in many cases, through the hydraulic control system of the tractor.

The modern hydraulic control system supplies power to raise, lower, or set equipment at any in-between working position desired. On general-purpose tractors, integral equipment is controlled through the tractor rockshafts; drawn equipment is controlled through the remote cylinder which attaches to the implement and is connected to the tractor by flexible oil lines. On standard-type tractors, hydraulic power can be used to raise, lower, or adjust drawn equipment through the remote cylinder.

There are two general types of internal-combustion engines—two-stroke cycle and four-stroke cycle. The two-stroke cycle engine has a power impulse or working stroke every revolution. The four-stroke cycle engine burns its fuel charge every second revolution. There are four strokes of the piston from one power impulse to the next. Practically all farm engines and tractors are of the four-cycle type, either spark ignition or Diesel.

The strokes of the spark ignition engine are:

First: suction or intake. Here, the piston draws a charge of fuel and air into the cylinder through the inlet valve.

Second: compression. The piston, on its return, compresses the fuel and air mixture into the end of the cylinder called the combustion chamber. Full power is secured only with good compression.

Third: expansion or power stroke. At a point slightly in advance of full compression, an electric spark, produced by a magneto or battery, ignites the fuel. This causes a sudden high expansion pressure to act on the piston, pushing it back so that work is performed.

Fourth: exhaust. On its return from the power stroke, the piston pushes the burned gases out of the cylinder, through the open exhaust valve, and then through the exhaust manifold.

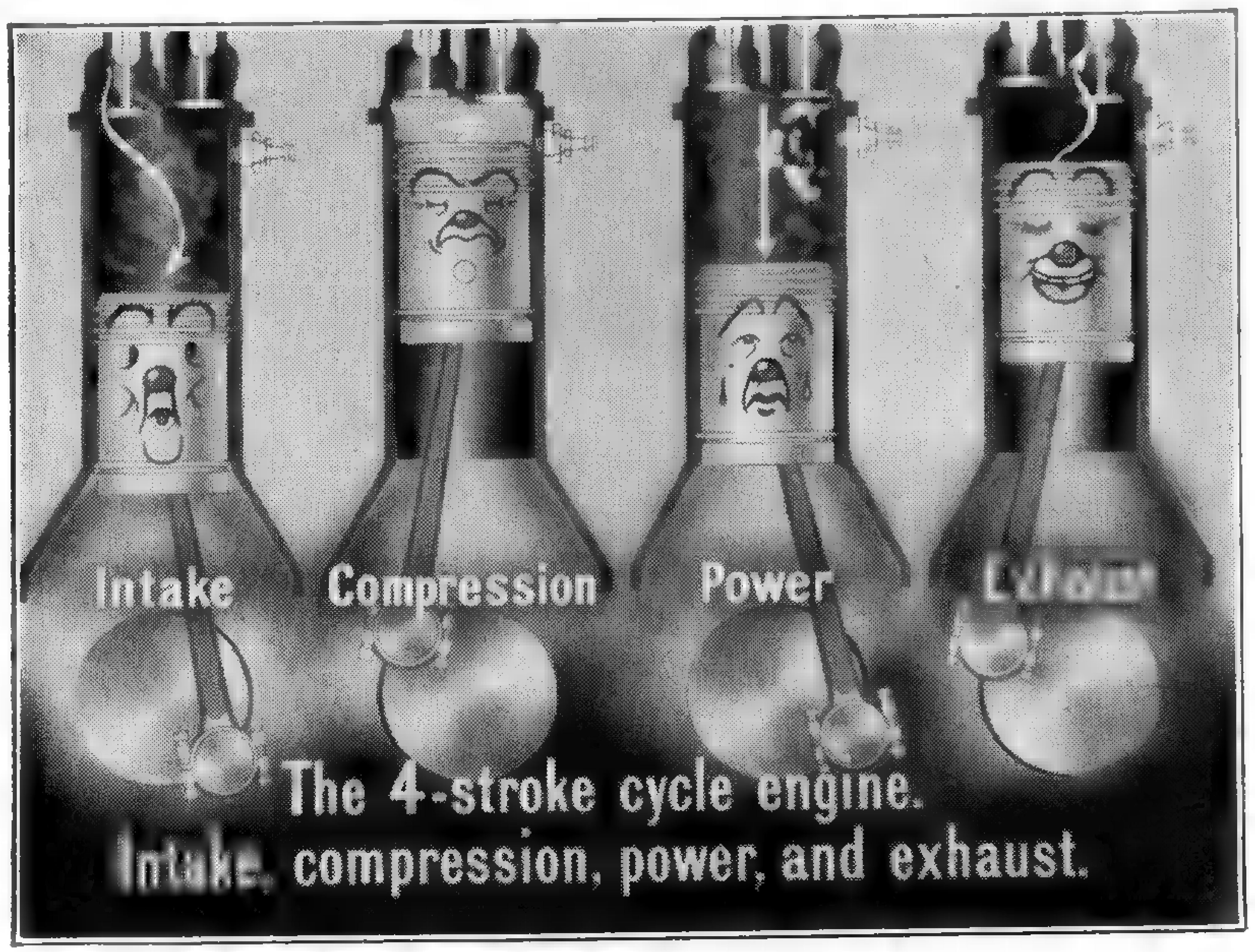


Figure 20—Illustrating the four strokes of the four-cycle engine.

It is well known that air or gas under pressure produces heat. The Diesel engine utilizes this principle to burn the fuel. That is, air is compressed until the resulting high temperature is sufficient to ignite the fuel injected after compression is practically completed. Since the temperature of compression is well above the minimum fuel combustion temperature, no ignition devices or spark plugs are required.

The strokes of the Diesel are similar to those of the spark-ignition engine except in the third, or power stroke, at which point the fuel is burned. Just before the piston reaches the end of the compression stroke, fuel is injected into the combustion chamber and ignition, induced by the heat of compression, begins as the piston approaches the top of the stroke. If the fuel were drawn in with the air, under most conditions it would ignite before the end of the compression stroke, making the engine buck or attempt to run backwards. Therefore, fuel must be injected at or slightly before the end of the compression stroke. The expanding gases, released by the combustion

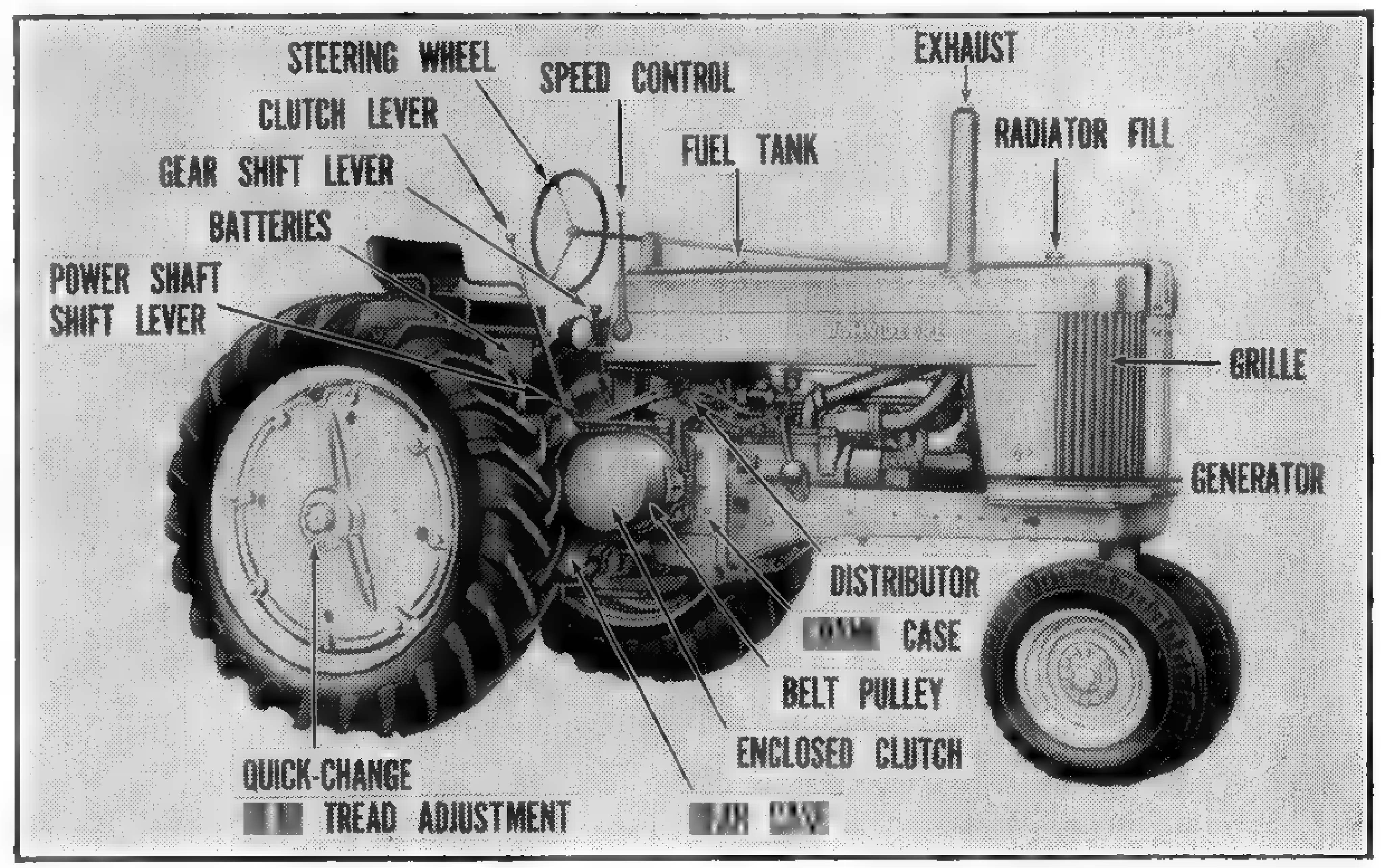


Figure 21—Adjustable rear-wheel tread, general-purpose tractor.

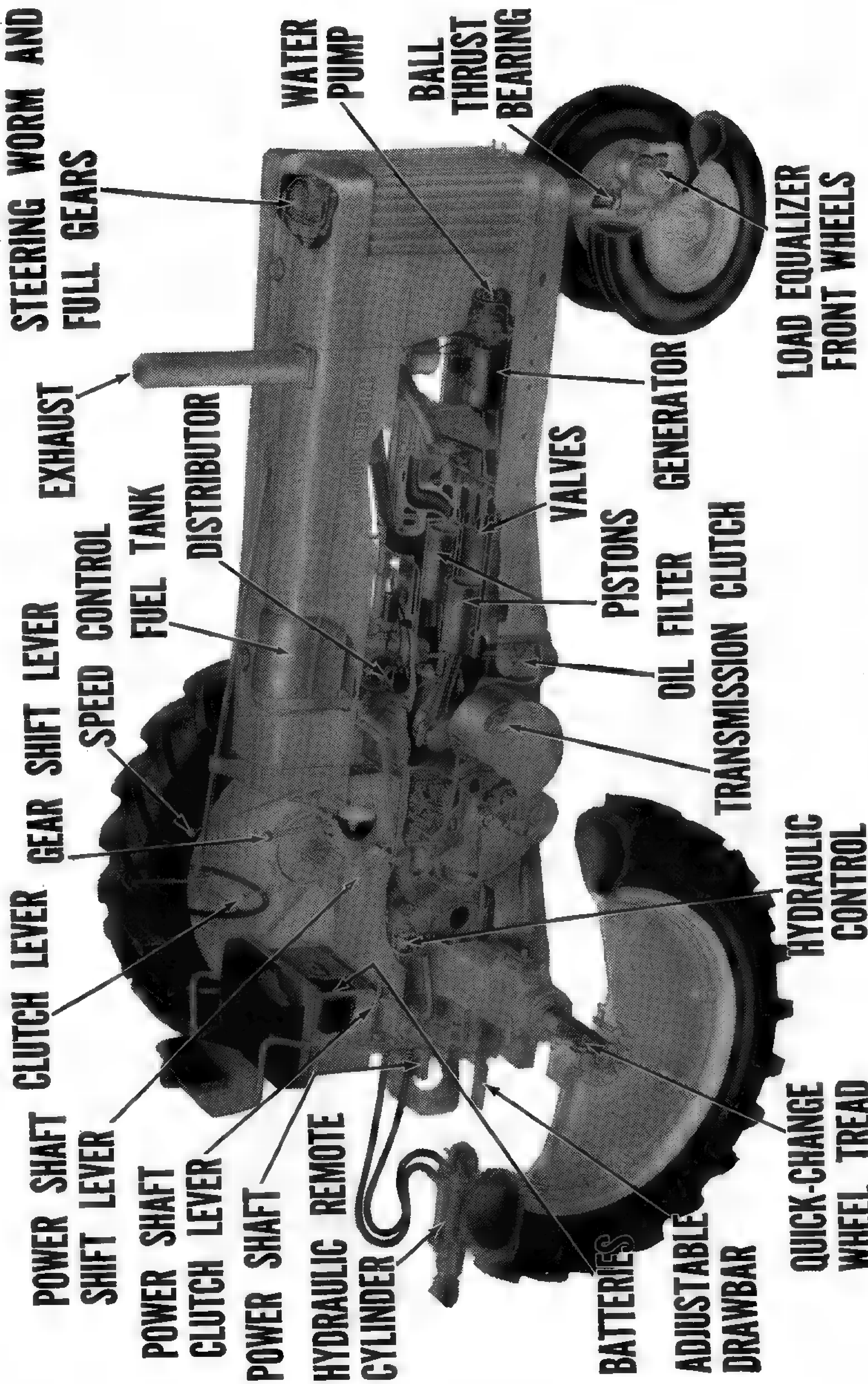


Figure 22—Cross-section view of the general-purpose type tractor.

of the fuel, force the piston back to exert power on the crankshaft.

Thus, on all types of four-cycle engines these events—*suction* or *intake, compression, expansion* or *power*, and *exhaust*—make the complete cycle.

Spark-Ignition Engine. For the discussion of this part of the chapter, the tractor shown in Figs. 21 and 22 will be used as a basis. It is a typical general-purpose farm tractor having a two-cylinder, horizontal engine available in two types: with high compression ratio, to burn gasoline, and, with lower compression ratio, to burn the heavier fuels such as distillate and tractor fuel, and gasoline also.

When a new tractor is delivered, it is ready to give efficient service for a long time, under normal conditions, without a great amount of adjustment. The operator's chief responsibility is in correct lubrication and proper care. However, when trouble arises, the operator should be capable of analyzing his tractor and making the day-to-day adjustments that fall within the range of his skill and the equipment of his farm shop.

As the source of tractor power, the engine of the tractor is in operation during every minute the tractor is at work whether on drawbar, belt, or power take-off. For this reason, it is well to gain a thorough understanding of the essential requirements for most efficient engine operation.

Air-Fuel System. It is wise to consider fuel and air at the same time, for the successful operation of the engine depends upon a correctly-proportioned mixture of fuel with air. The proportions are controlled by adjustment of needle valves on the carburetor. When the mixture is correct, the engine runs smoothly, delivering its maximum power; too much fuel in the mixture, called a "rich" mixture, is indicated by a black, smoky exhaust and irregular running of the engine; too little fuel, called a "lean" mixture, is indicated by a "popping back" through the car-

buretor, misfiring of the engine, or by a high-pitched "ping" referred to as a pre-ignition knock.

The fuel system of the gasoline tractor, which will be discussed more completely in this chapter, consists of the fuel tank, carburetor, and manifold. The all-fuel tractor, on the other hand, has a fuel system consisting of the fuel tank, a small tank for gasoline used in starting, a three-way valve which permits the flow of fuel from either tank, and a carburetor and manifold.

Gasoline is drawn into the carburetor which serves to atomize the fuel in air, producing a highly combustible gas. This gas is drawn into the combustion chambers, placed under pressure by the piston on its compression stroke and ignited or burned by a spark, timed to fire at the proper instant to deliver full power of the burning fuel to the piston.

The Carburetor. Fuel must stay liquid while in the carburetor until discharged in the form of a fine spray through a nozzle. The carburetor has its own local fuel supply (float bowl) carried at a constant level by means of a float. The nozzle or jet forces the liquid fuel from this bowl into the air stream. Nozzles are located centrally in what is called a venturi tube or barrel which is a constricted section of the intake manifold designed to increase greatly the velocity of air at this point.

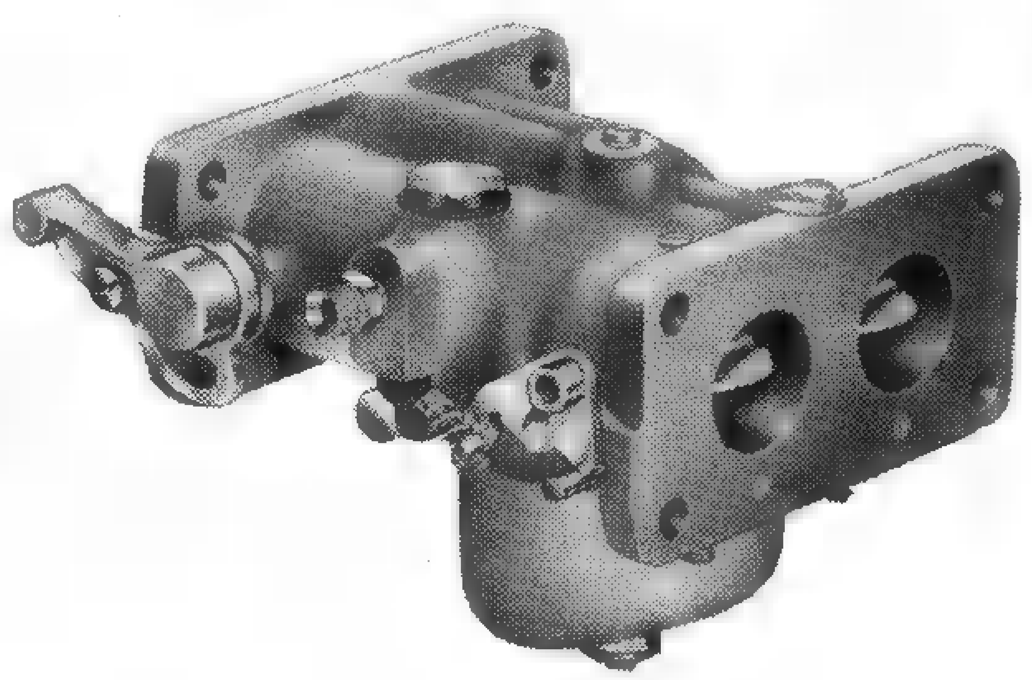


Figure 23—The duplex carburetor meters identical amounts of fuel and air to each cylinder.

The tractor shown in Fig. 21 is equipped with duplex carburetion. (Fig. 23.) This carburetor has two venturi which meter fuel in identical amounts to each cylinder, thus providing quicker response and smoother engine performance.

Increasing the air velocity increases the ability of the air stream to pick up the fuel from the nozzles and atomize it. The throttle, which controls the amount of fuel to reach the engine, is located beyond the jet nozzles and venturi tubes. In most tractors the throttle valve is controlled by a governor mechanism.

The manifold heat control valve, located in the engine manifold, improves engine performance and efficiency in hot and cold weather. (See Fig. 24.) Turning the valve to the "hot" position causes the exhaust gases to warm the incoming fuel and air mixture before it enters the combustion chamber of the engine. This position is used in cold weather, below 32° F.

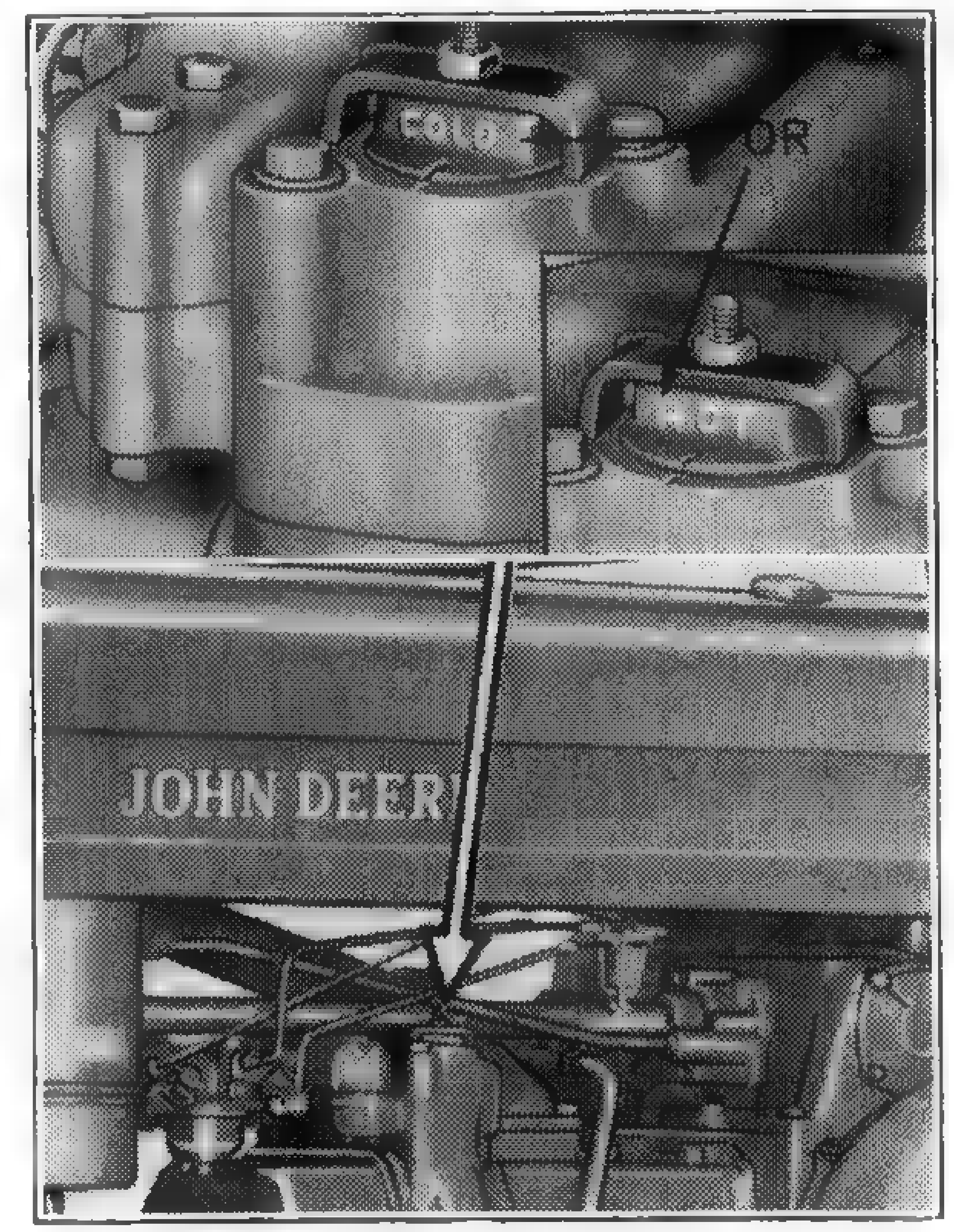


Figure 24—Two-position manifold valve, set at the hot position, *right*, diverts exhaust gases to pre-heat incoming fuel for cold weather operation.

Cold setting, *left*, expels burned gases directly into exhaust, keeping the incoming fuel mixture cooler in hot weather.

Turning the valve to the "cold" position causes the hot gases to leave the engine without warming the incoming fuel and air mixture. This position is for use in weather above 32° F.

Checking the Fuel System. When any one or more of the three essentials, fuel, air, or spark, is deficient or lacking, the engine will operate poorly or fail entirely to operate. It is wise, therefore, to check the "important three" for lack of efficiency in the engine, difficult starting, or entire failure to start. In checking the tractor, start with first essentials first and check through each possible source of trouble.

This procedure eliminates guesswork and removes the need for "back tracking" in making the service checkup.

The most important point in caring for and adjusting the fuel system is keeping out dust and dirt. Fuel should always be stored in clean containers, protected from dust, dirt, and water; it should always be strained when filling the tanks. When engine trouble occurs, it is well to look for the cause of the trouble in the fuel system first.

First, shut off the fuel at the fuel filter by turning the shut-off valve. Then, remove the glass bowl and clean it thoroughly. After the bowl is removed, turn the shut-off valve to see if fuel flows readily from the tank. If not, the tank must be cleaned. Replace the fuel bowl, being sure the gasket fits properly and the screen is clean and in good condition. All fuel lines should be checked.

The screen of the gasoline carburetor can be cleaned easily. Flush the sump by removing the sump plug and turning on the fuel. Then, remove the strainer plug with attached screen. Clean the screen and replace screen and plug.

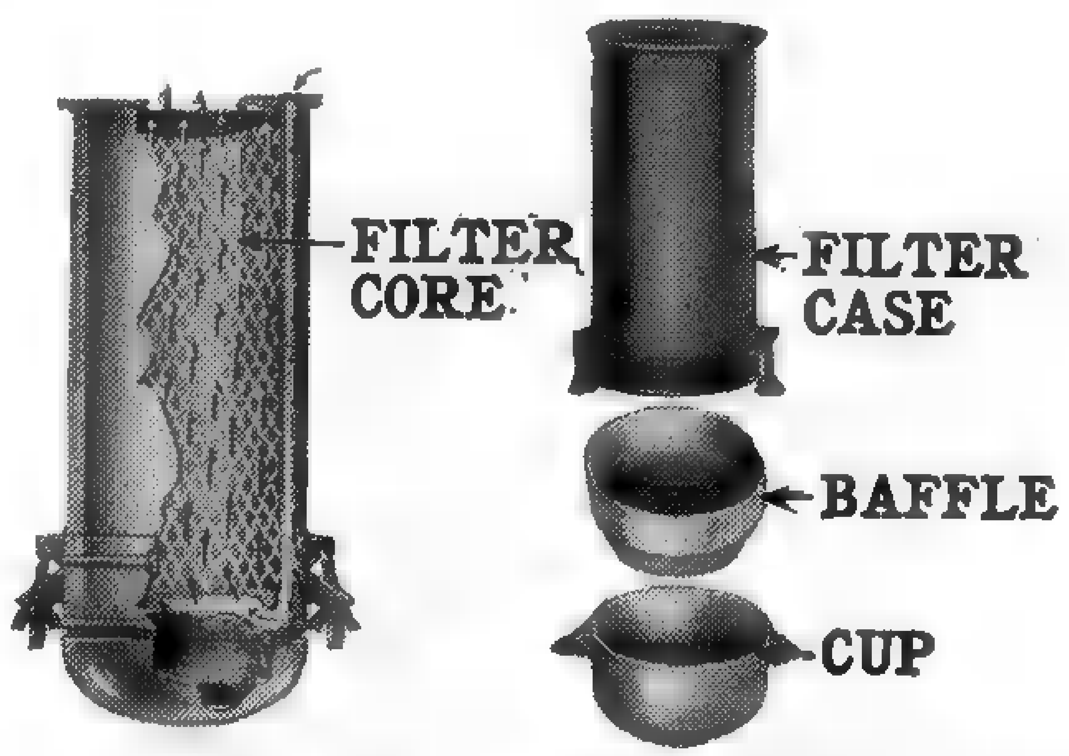


Figure 25—Air cleaner shown in cross-section disassembled for servicing.

Checking Air Cleaner. When we consider that every gallon of liquid fuel consumed by the engine must be mixed with nine thousand gallons of air, the importance of the air cleaner (Figs. 25 and 26) becomes apparent. The sole function of the air cleaner is to provide a continuous flow of clean air to the carburetor where it is mixed with the fuel and drawn into the combustion chamber. The air cleaner removes from incoming air, dust and grit particles that would injure the cylinders and working parts if drawn into the combustion chamber. As the air is drawn into the cleaner, the dust and heavier particles of dirt are caught and retained in a mist of oil created by the draft of air drawn through the cleaner.

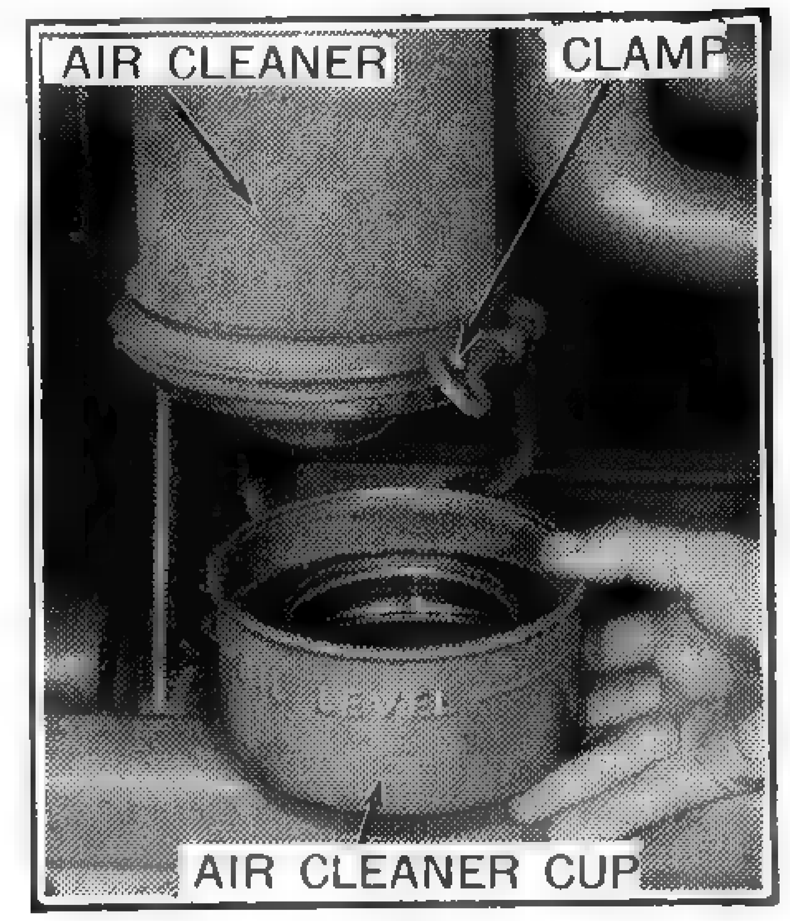


Figure 26—Air cleaner should be checked every ten hours.

Before each day's work, the oil sediment cup at base of filter should be detached. If the oil is thick with suspended dirt or if there is more than 1/2-inch of dirt in the bottom, the air cleaner should be serviced. It should be serviced at least every 30 hours. The dirt-filled oil should be removed, and the entire cup washed in kerosene to remove all the sediment. (See Fig. 26.) The cup should then be refilled to bead mark with new engine oil and replaced. When engine difficulties occur, the air cleaner should be given a routine check since a clogged air cleaner or a badly dented or crimped air intake may so constrict the passage of air as to make engine operation impossible.

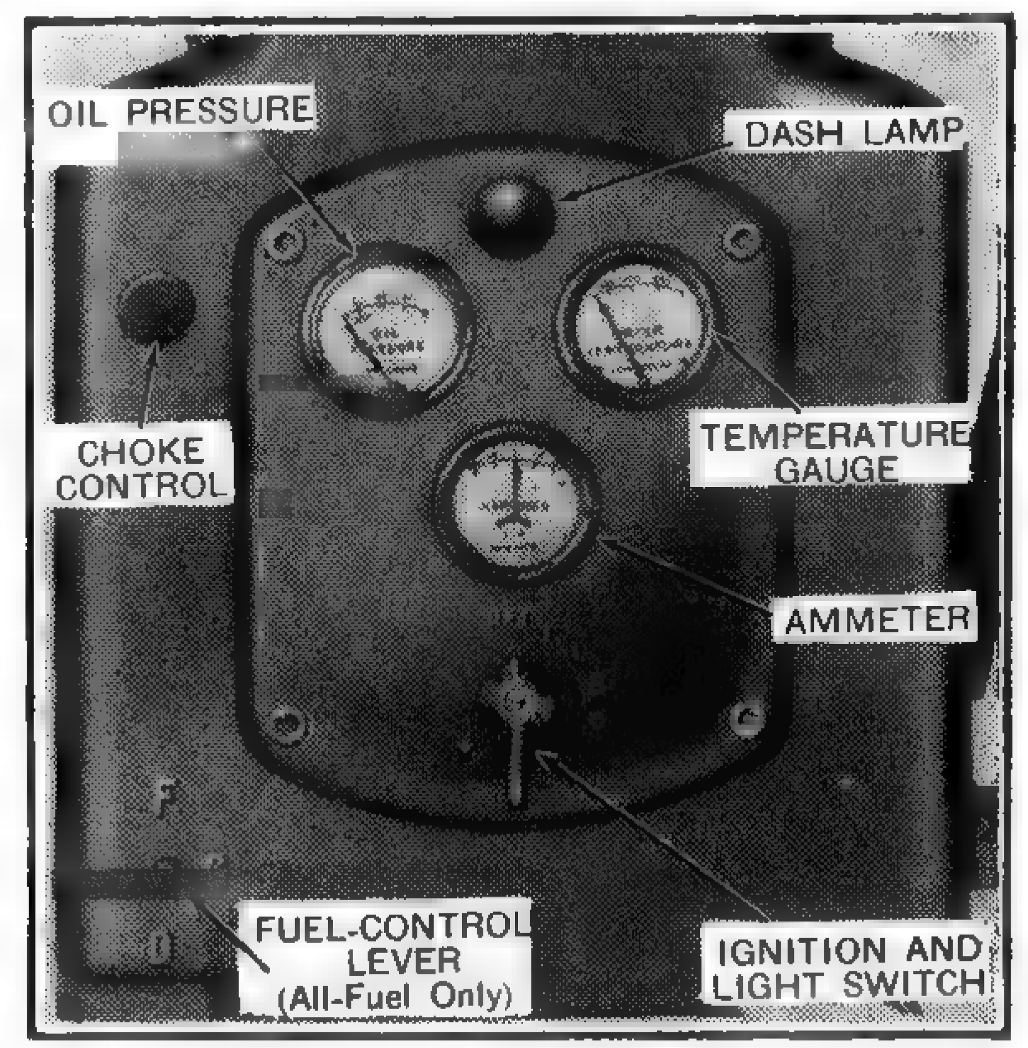


Figure 27—Most tractors are equipped with instrument panels similar to this shown, including the oil-pressure gauge, dash lamp, water temperature gauge, ammeter, choke control, and ignition and light switch. Fuel control lever used on all-fuel tractors.

Ignition System. In the spark-ignition type tractor engines, the air-fuel charge is ignited by means of a high-voltage electrical spark jumping a spark plug gap. There are two common types of ignition systems: (1) the battery distributor and (2) magneto. The principal difference in the two systems is the primary source of electrical current.

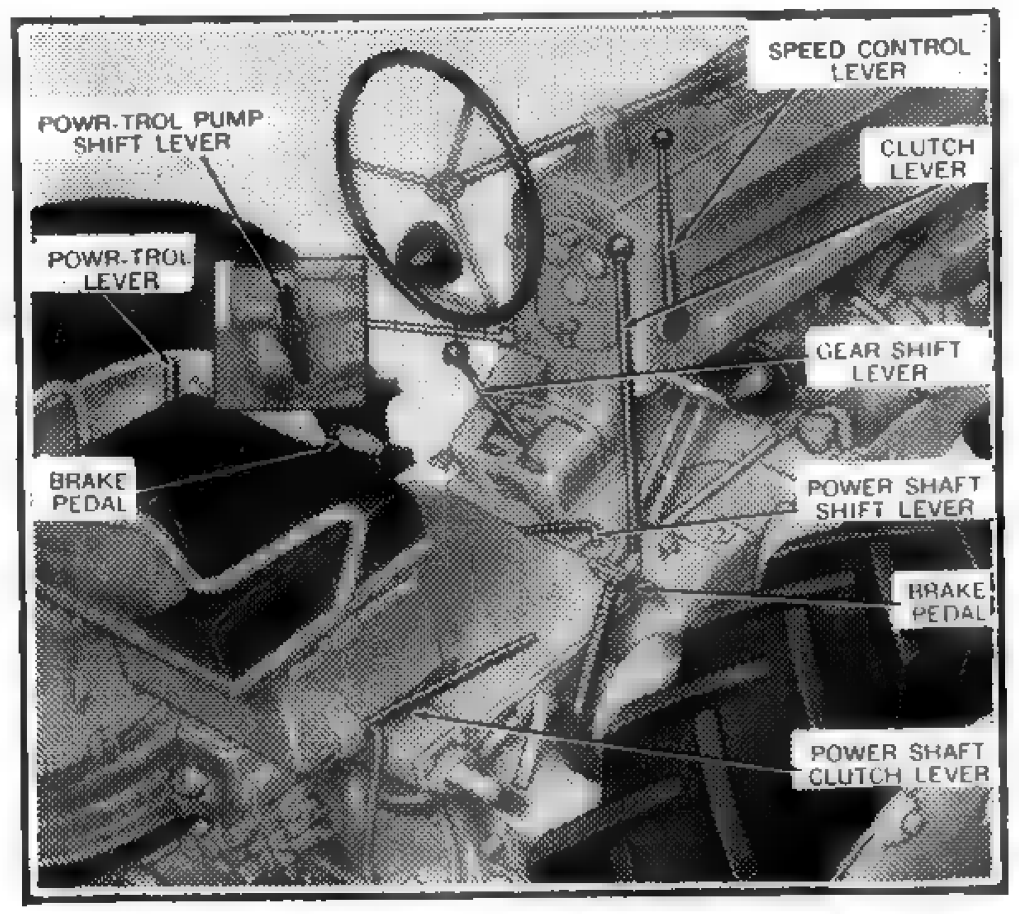


Figure 28—A tractor should have all operating controls convenient to the tractor operator, including the throttle or speed control lever, clutch lever, gear shift lever, power shaft shift lever, brake pedals, power shaft clutch lever, and hydraulic remote or rockshaft lever.

In the battery system the necessary current is produced by chemical action within the battery, while in the magneto system the armature of the magneto is rotated to produce current. The battery system will be discussed more thoroughly in this text.

The battery- distributor-type ignition system consists of a battery, a coil which transforms low voltage current to high voltage, a distributor which carries the high voltage current to the proper plug, and the spark plugs which release the spark in the combustion chamber. In this type of system, a generator is required to keep the battery charged and there must also be a switch to break the circuit so that the battery will not discharge when the engine is not in operation.

Figure 29—Simple method for checking spark at spark plug.

Checking the Ignition System. With fuel and air flow established, check the ignition system to make certain that a good "hot" spark reaches the compressed gas. To check for spark at the combustion chamber, remove spark plug wire, leaving spark plug in position, and hold end 1/4-inch from the engine as shown in Fig. 29. Turn flywheel, or crank the engine. If sparks jump from end of wire to the engine, the ignition system and spark plug wires are in good condition; spark plugs are at fault.

If the plug is dirty, it should be cleaned. If the porcelain insulator is cracked, the plug must be replaced. The electrode gap should be spaced .030-inch; always use a spark plug gauge for correct setting. (See Fig. 30.)

If no spark occurs upon checking at the terminal, check the source of spark, the distributor. Remove the switch-to-distributor lead from the distributor circuit. Place the opposite end of the lead 1/4-inch from some metal part of the tractor. If no spark occurs, the trouble is in the battery-distributor circuit.

If spark does occur here, the distributor is operating satisfactorily; it is evident then that spark-plug wires are broken or badly frayed, or that the insulation has deteriorated with age, causing a short circuit which "grounds" the spark before it reaches the plug. Replace spark plug wires. If no sparks occur upon checking in this manner, remove distributor cap and check points for proper clearance as given in your tractor instruction book or service

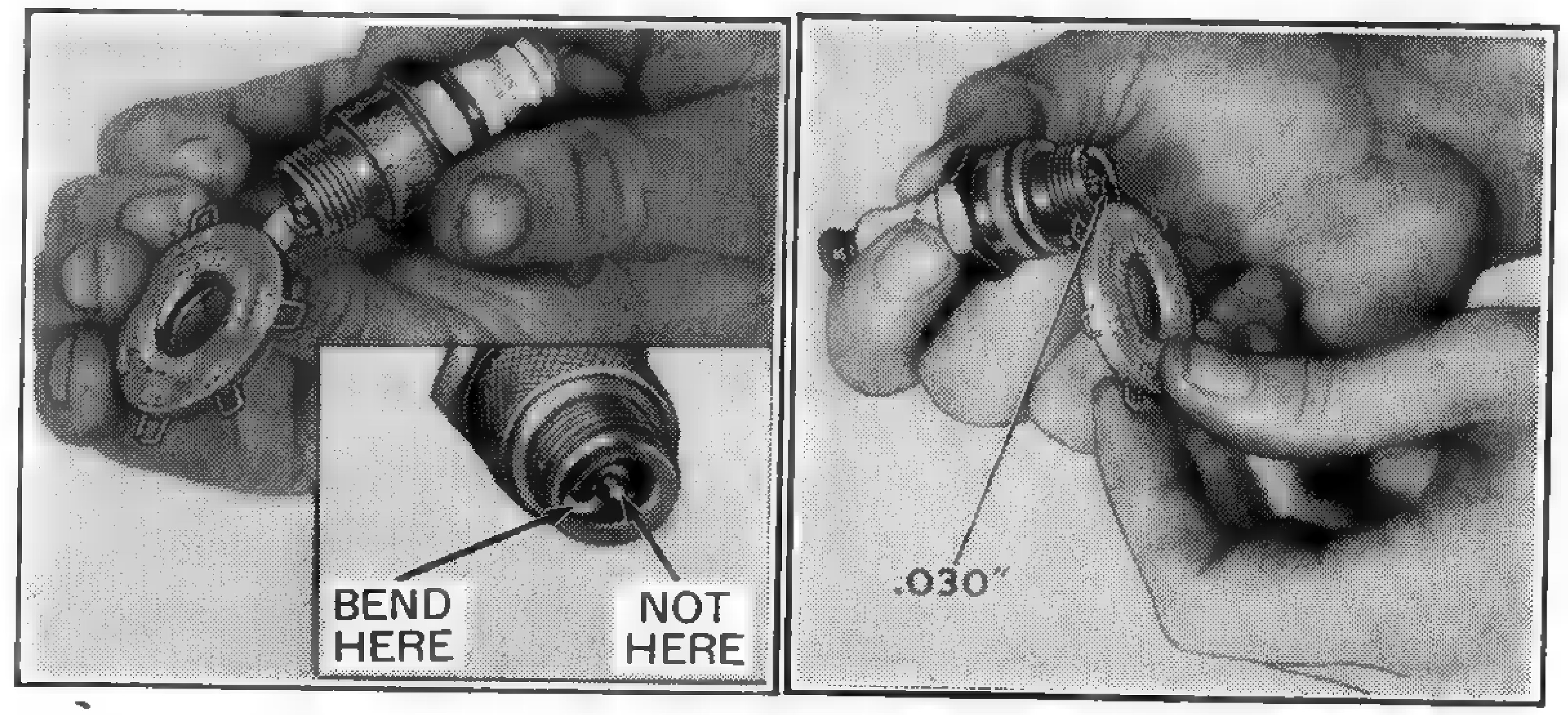


Figure 30—Plugs should be cleaned frequently and spaced to .030-inch.

manual. If points are badly pitted, burned, or dirty, they should be replaced. Otherwise carefully remove them, clean and dress each point to a smooth flat surface, using a fine hone. Do not file points. It is not necessary to remove pits. Just be sure the surfaces are clean and flat.

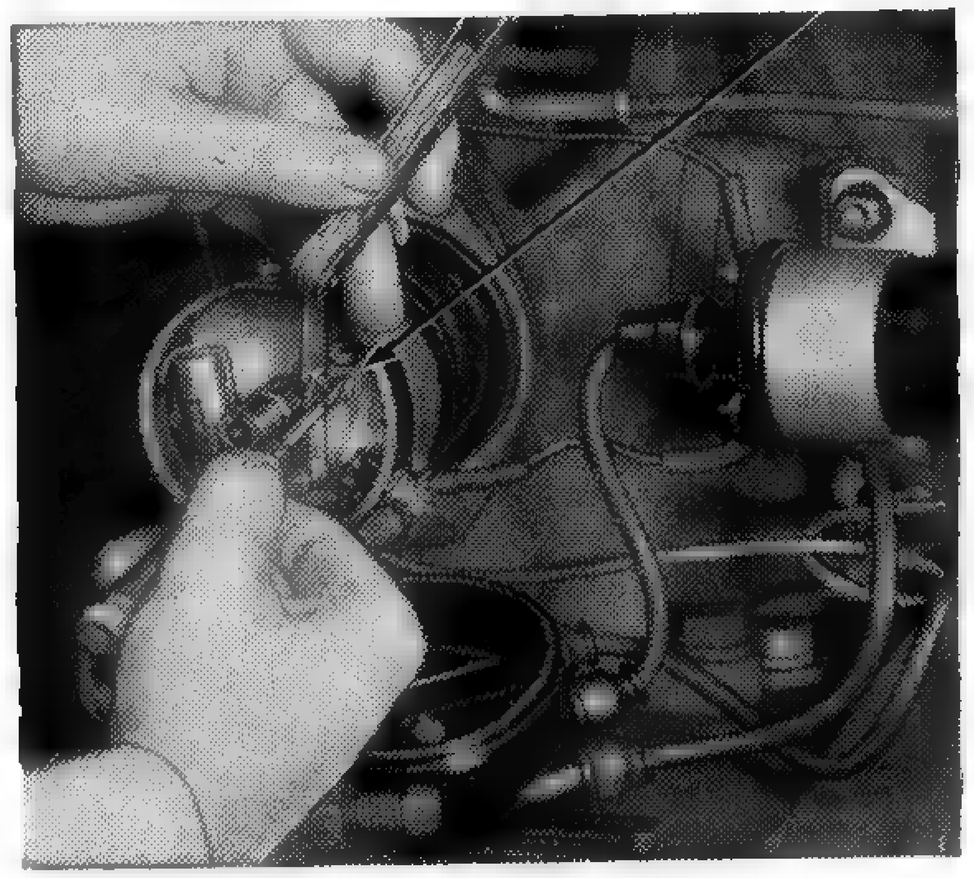


Figure 31—Adjusting the distributor breaker point gap, set at .021-inch

With points replaced and properly gapped or spaced, check again. If no sparks occur, remove the unit and take it to your tractor service dealer for repair. Ignition repairs call for a fine degree of skill and the use of special shop equipment; for this reason, it is unwise to attempt repairs in the farm shop. When replacing the ignition parts, follow the manufacturer's instruction book for correct procedure to insure proper "timing" or firing order of the cylinders.

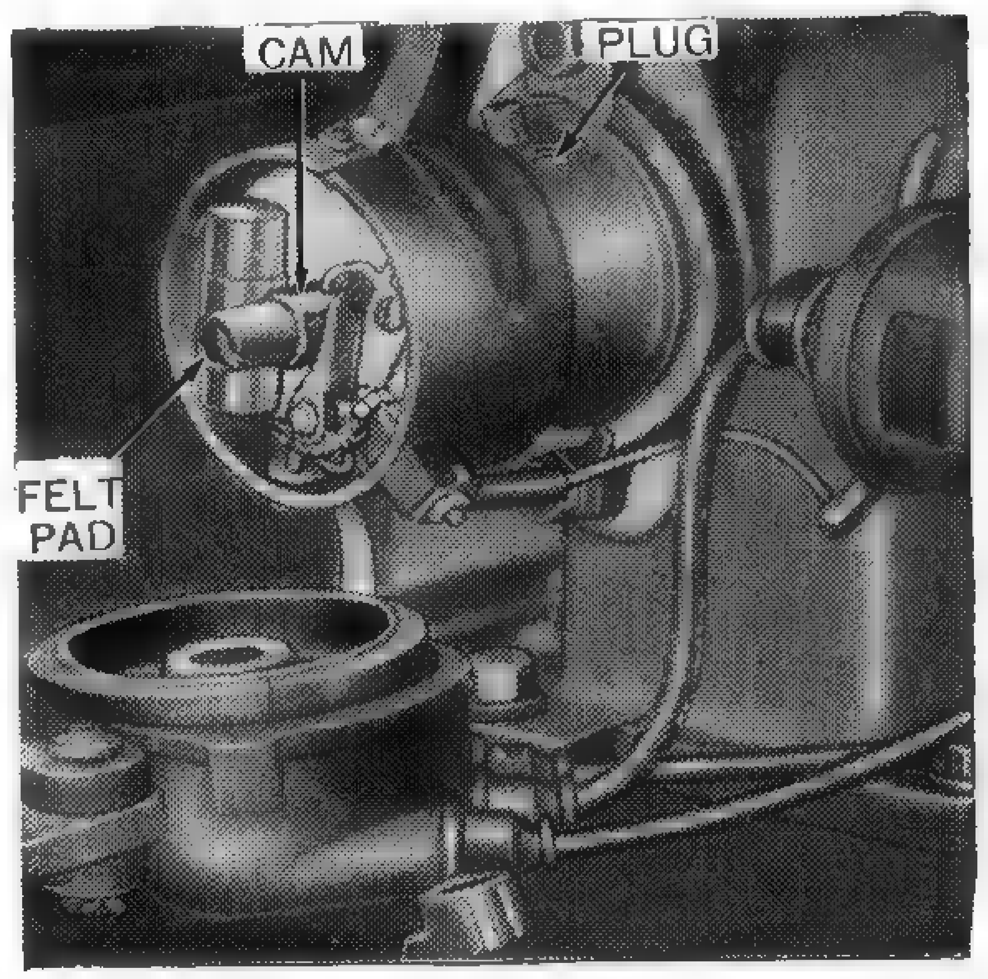


Figure 32—Servicing a distributor is simple; grease breaker point cam and oil felt pad on end of cam as per manufacturer's directions

The magneto-type ignition system can be checked in a similar manner. Complete instructions will be given in your tractor operator's manual.

The Battery and Its Care. The battery stores chemical energy which can be converted into electrical energy whenever you need it, for starting and operating the engine, lights, etc.

Many present-day tractors are equipped with 12-volt systems to provide power for lights, starters, etc.

The tractor under discussion (Fig. 21) is equipped with such a system. It includes a heavy-duty battery with a rubber case and anti-leak battery caps. No other battery should be used as replacement; be sure only a battery recommended by the manufacturer is used as a replacement on your tractor.

Figure 33—Battery should be checked at frequent intervals. Here the specific gravity is being checked with a hydrometer.

At least every 30 days or every 120 hours the battery should be wiped off with a damp cloth. Loosen any corrosion around terminal connections and apply a solution of 1/4 pound of soda to one quart of water. Flush the outside of the battery with clear water. Make sure the vent holes are open in each cap. Battery connections should be clean and tight; a coating of vaseline on each terminal connection will retard the accumulation of corrosion.

Check the electrolyte (acid and water level) in the battery every 120 hours or 30 days for proper level—more frequently in hot weather. Add distilled or soft water (if not available, use drinking water) until the recommended level is reached. Never permit the electrolyte level to go lower than the top of the cell plates. Never add water in freezing weather until after the engine has started; water will not mix with the electrolyte until the generator passes a charging current into the battery.

The specific gravity of the electrolyte should be checked with an accurate hydrometer before adding water. (See Fig. 33.) Specific gravity should not go below 1.225 which

is half charge. When fully charged the reading will be approximately 1.240 to 1.255, depending on make of battery.

Cold weather affects the battery adversely in several ways. It reduces the output of the battery even if fully charged. Freezing weather may damage a battery beyond repair. Therefore, never allow a battery to stand long in the winter time without checking its conditions and recharging if necessary.

If you are having trouble keeping the battery charged during cold weather, moving the wire from one terminal to another converts the current voltage regulator into a straight voltage regulator and permits a higher charging rate and consequently a faster build-up of the battery. See your operator's manual for complete instructions before making this change.

Always follow the manufacturer's suggestions in storing a battery or installing the battery in the tractor.

Starting and Lighting Equipment. This equipment, more and more widely used on modern tractors, requires but a small amount of attention. However, it is highly important that what little servicing is required should be done at periodic intervals so that the system will function properly and dependably.

Starting and lighting equipment includes three important units: the storage battery, already discussed; the generator, which develops the energy to be stored in the battery; and the starting motor, which is called upon to "turn over" or crank the tractor engine.

The generator converts mechanical energy into electrical energy. The charging rate, set at maximum inside the generator, is controlled by the voltage regulator used to prevent overcharging of the battery. Generator output, or charging rate, should be regulated to the demand made upon the battery for starting and lighting. If you operate your tractor without the use of lights or use them only

occasionally, the generator charging rate should be reduced. If, during busy seasons, you operate all night, the charge rate must be increased to maintain the battery at full charge. To change charging rate, remove the generator dust band and loosen the brush-holder screw. Move the brush in direction armature rotates to increase, and move in opposite direction to decrease. After obtaining desired charging rate, tighten the brush-holder screw. Replace the cover band, making sure it is tight and covers the openings properly.

The generator should be lubricated sparingly, only a few drops of oil at a time. The drive belt should be adjusted for proper tension. See your operator's manual for complete instructions.

All connections in the entire system should be kept clean and snug-fitting. When your new tractor is delivered with starting and lighting equipment, it is advisable to check carefully the instructions covering this equipment to familiarize yourself with the servicing required.

Checking Compression. As mentioned previously, efficient engine operation depends upon proper mixture of fuel and air, proper compression in the combustion chamber, and spark properly timed to ignite the mixture.

We have discussed the method of checking the fuel system, the air flow to the carburetor, and the ignition system; compression should be the next point to be given consideration.

Proper compression requires a perfect seal of the combustion chamber which will insure full power from every charge of fuel entering the chamber. Two factors are involved in gaining the perfect seal necessary for efficient operation: proper seating of the valves (which permit intake of fuel and passage of burned gases and which are "timed" to close at the time of the power stroke to seal the combustion chamber), and proper fit of pistons and piston

rings which seal the chamber to prevent passage of gas and power between piston and cylinder wall.

As the piston moves forward in the cylinder, it compresses

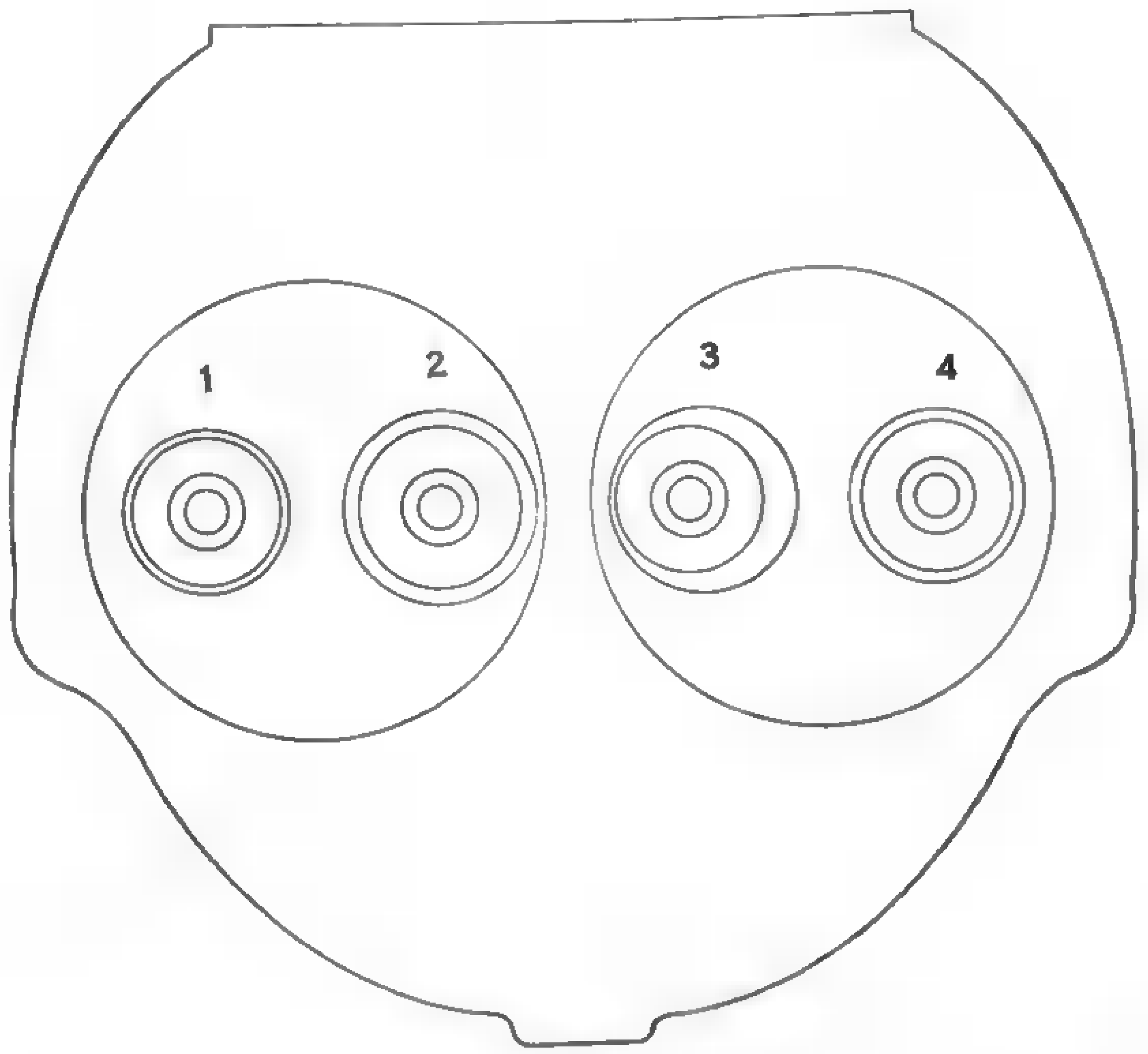
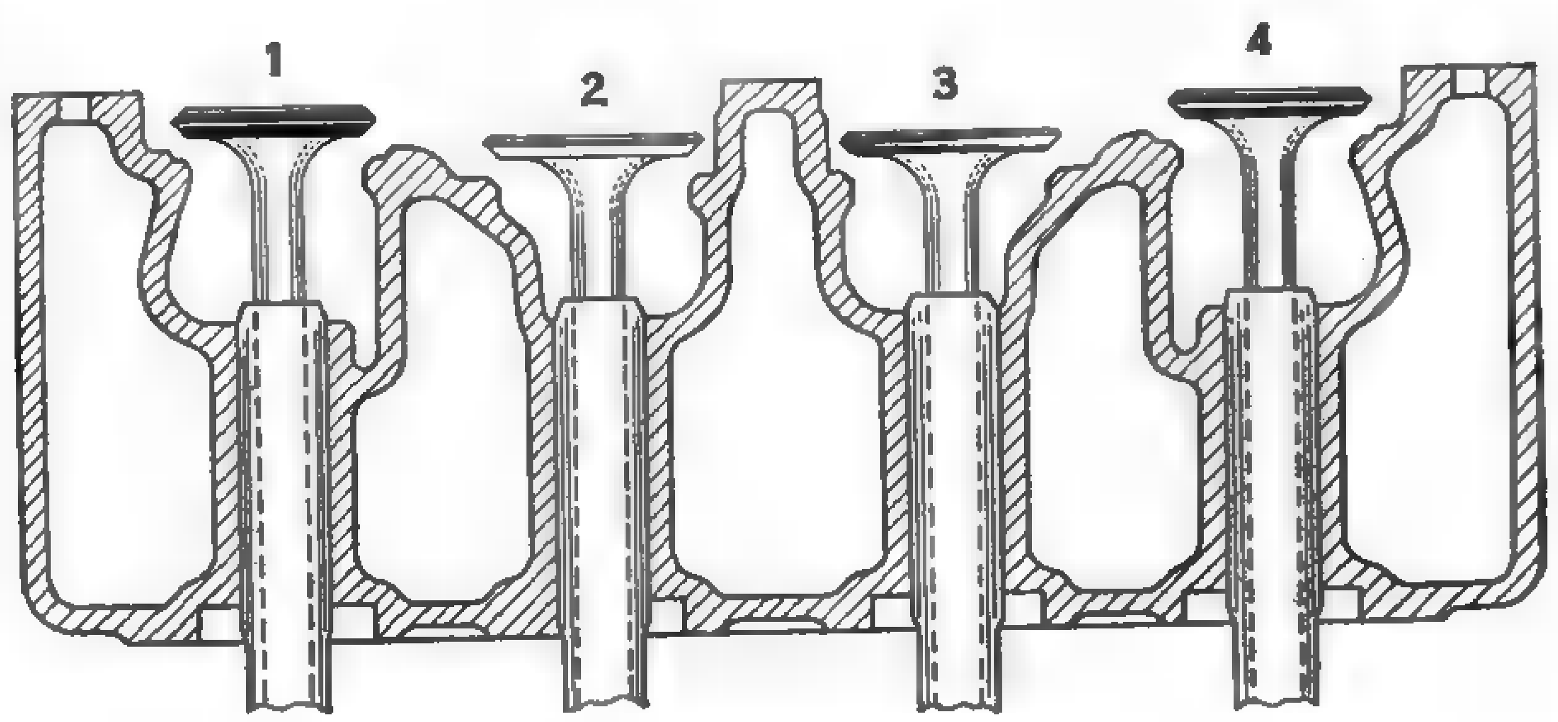


Figure 34—The ideal valve seat is one that forms a perfect seal of uniform width over the complete circumference of the valve-port. A seat too narrow (1) tends to cut or pound a groove in the valve, resulting in lost compression. With the seat too wide (2), it is almost impossible to get a perfect seal and, here again, loss of compression results.

Where the seat has been worn off center (3) due to worn valve guide or any other cause, it is impossible to obtain the proper seal between valve and seat which results in lost compression and uneven operation of the engine.

The properly seated valve (4) forms the perfect compression seal, and insures proper engine performance for the longest period. Width of seat varies with power and type of engine. See manufacturer's instruction book or consult your dealer for exact width for your engine.



the air in the combustion chamber creating a "cushion" of air. When cranking the engine, this cushion will be noted as each piston approaches "dead center," or the end of its stroke. If no definite cushion or compression is noted at uniform intervals as the engine is cranked, weak compression is indicated.

Energy required to turn the engine should be alike for all cylinders indicating that compression is equal in all

Figure 35—Complete valve assembly is shown at the right with principal parts named. Note especially the many precision-fitted parts where wear may occur to cause mis-alignment of the entire assembly. In servicing valves, all parts must be given skilled attention if engine efficiency is to be restored.

In illustration below, note that wear at top and bottom of the valve guide has caused mis-alignment of the entire valve. Obviously, valve cannot be seated properly until valve guide has been replaced

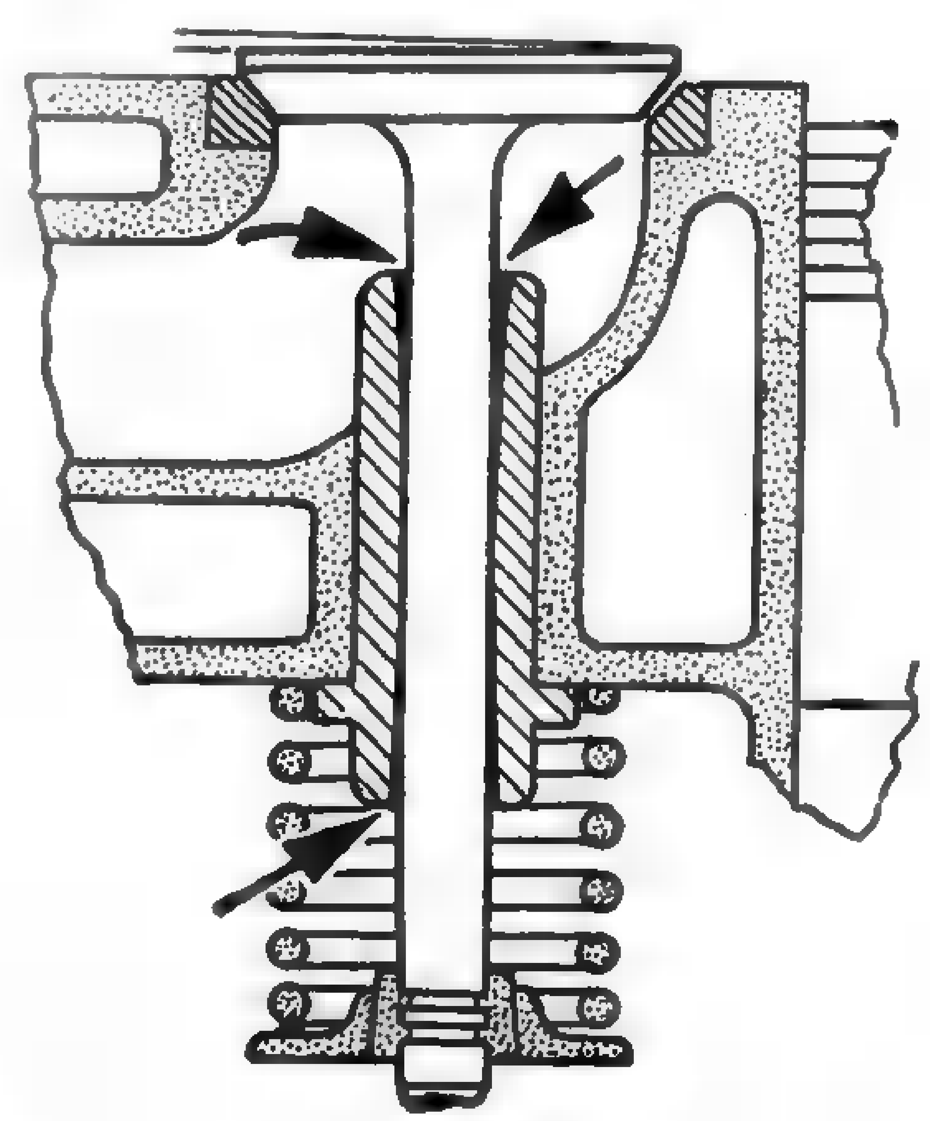
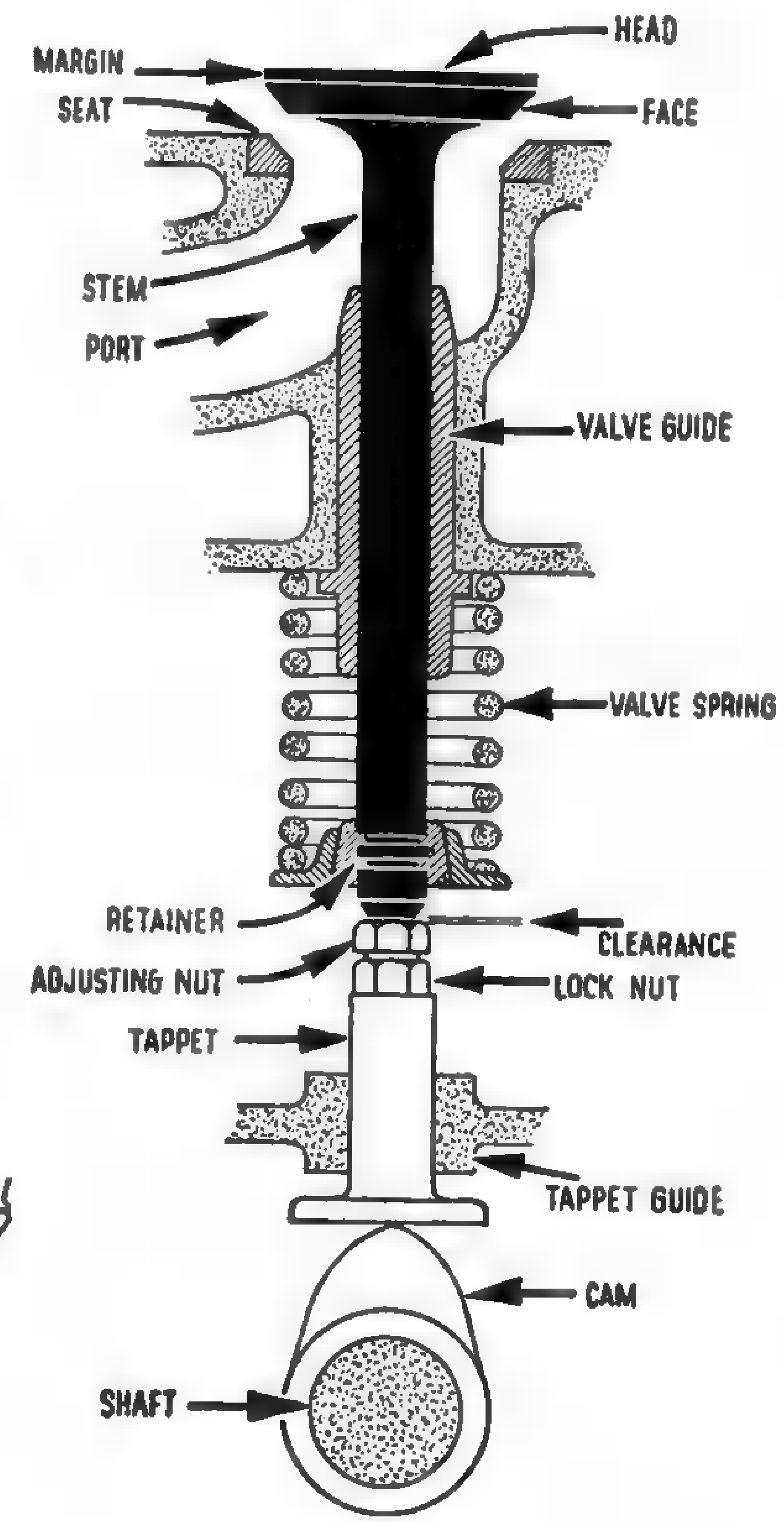


Illustration showing how worn valve guide affects proper seating.



Cross-sectional view of complete valve assembly with parts named.

cylinders. If energy required to bring one piston over center, or "compression," is greater than that required for another, or if a "hissing" sound indicating the escape of air is heard, compression is weak, with resultant loss of power under operating conditions.

The cause of poor compression may be found in poorly adjusted valves, improperly seated valves (see Fig. 34), worn valve guides (Fig. 35), worn piston rings or cylinder walls, or improperly sealed cylinder head gaskets which permit passage of air or water under pressure. Before attempting extensive repairs, it is well to check the valves for proper tappet clearance and adjust tappets to tolerances recommended in the instruction book or service manual for your particular tractor. Thickness gauges should be used in determining proper clearance (see Fig. 36).

If restoring proper tappet clearance fails to restore compression, it is well to enlist the aid of a skilled tractor serviceman to restore the engine to full efficiency. While the actual principles of engine construction and function are simple, the servicing of such parts as valves, pistons, and piston rings of the modern precision-built tractor involves the use of highly specialized equipment which the average farmer would find unprofitable to install in his home shop. The use of special steels in valves dictates the use of special stones and facing tools in their servicing (see Fig. 37); likewise, the highly precise job of

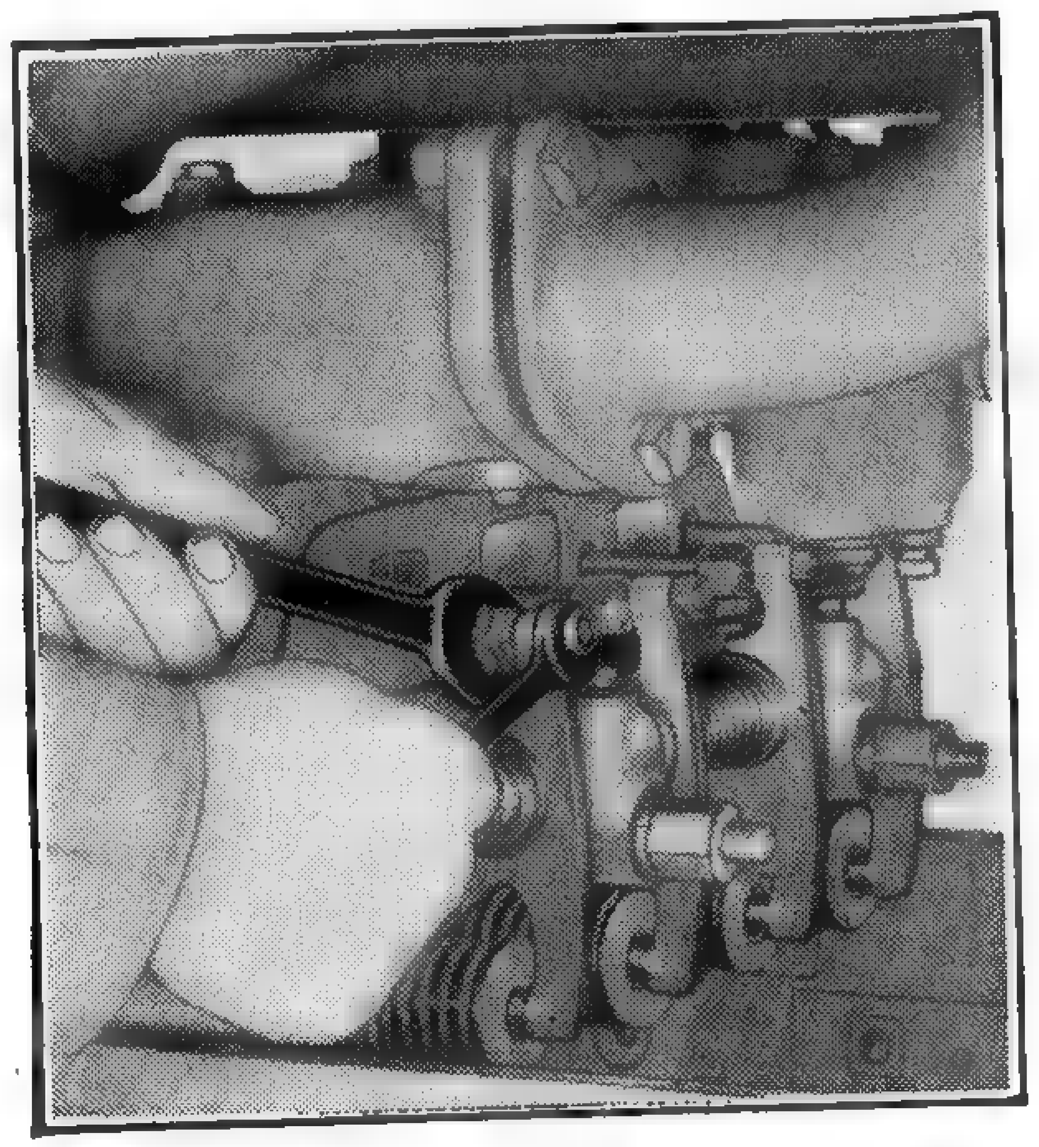


Figure 36—Thickness gauges should be used when adjusting valve tappet clearance.

replacing pistons, piston pins, and piston rings which involves removing and, in many cases, adjusting pressure lubricated bearings, is one for which special tools have been developed.

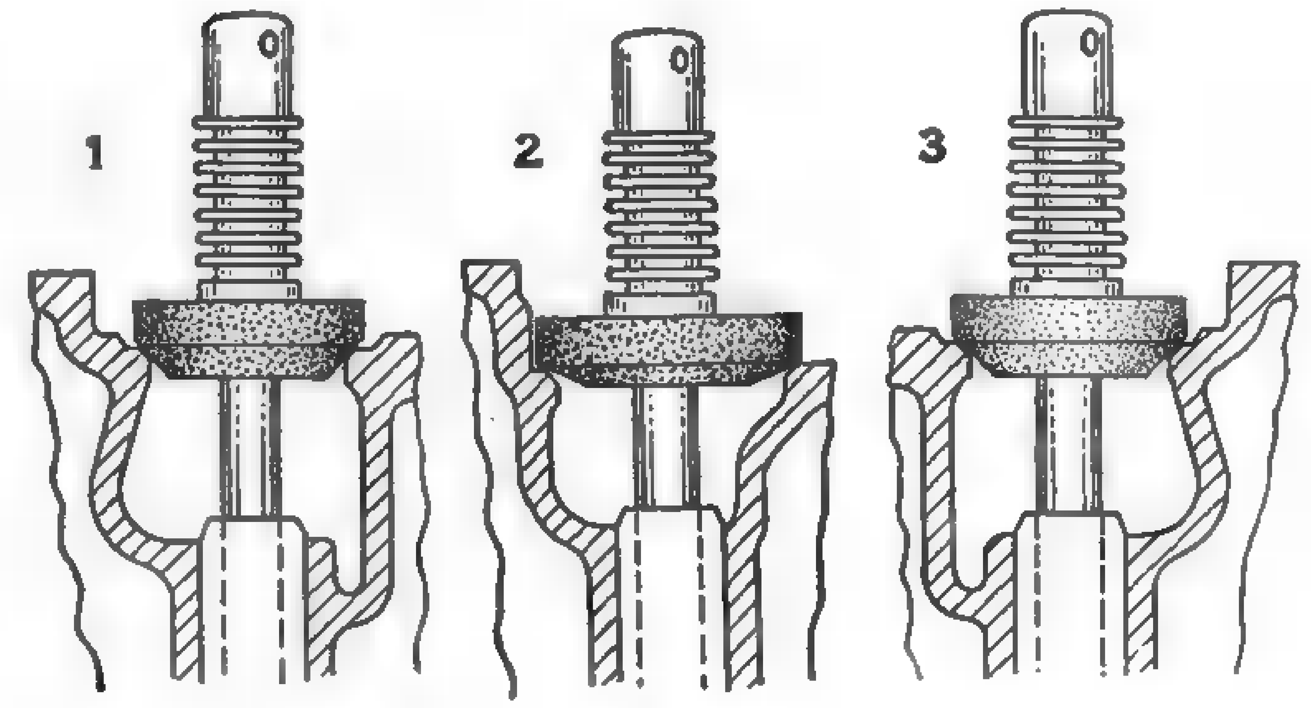


Figure 37—Special stones used in servicing valves. (1) Rough-cutting. (2) Rough stone used for narrowing the seat. (3) Fine stone for finishing.

Diesel Engines. While the Diesel engine is more costly to build, it has certain economy characteristics that enable it to convert fuel into horsepower at extremely low cost. It is for this reason that Diesel power is so effective in reducing costs on the heavier jobs where periods of operation are prolonged. It follows then, that Diesel power is used widely in the larger tractors, as shown in Figs. 17 and 38, in many stationary jobs such as hydraulic pumps and electric generators, and in railroads, trucks, and ships.

As mentioned on page 18, air only is drawn into the cylinder of the Diesel engine on the intake stroke. The engine speed is controlled by the amount of fuel injected. In order to assure satisfactory performance it is essential that only clean fuel be used in the Diesel engine. Every precaution is taken in the fuel system to keep the fuel clean.

The fuel system of the Diesel engine consists of the fuel tank, transfer pump, fuel filters, injection pump, and injectors. On the Diesel tractor shown, the incoming fuel flows by gravity from the tank into the glass sediment bowl where moisture and dirt settle out. (See Fig. 39.) The fuel flows on into the transfer pump which, in turn, forces the fuel through two micronic paper filters. These filters remove dust, dirt and abrasive materials which

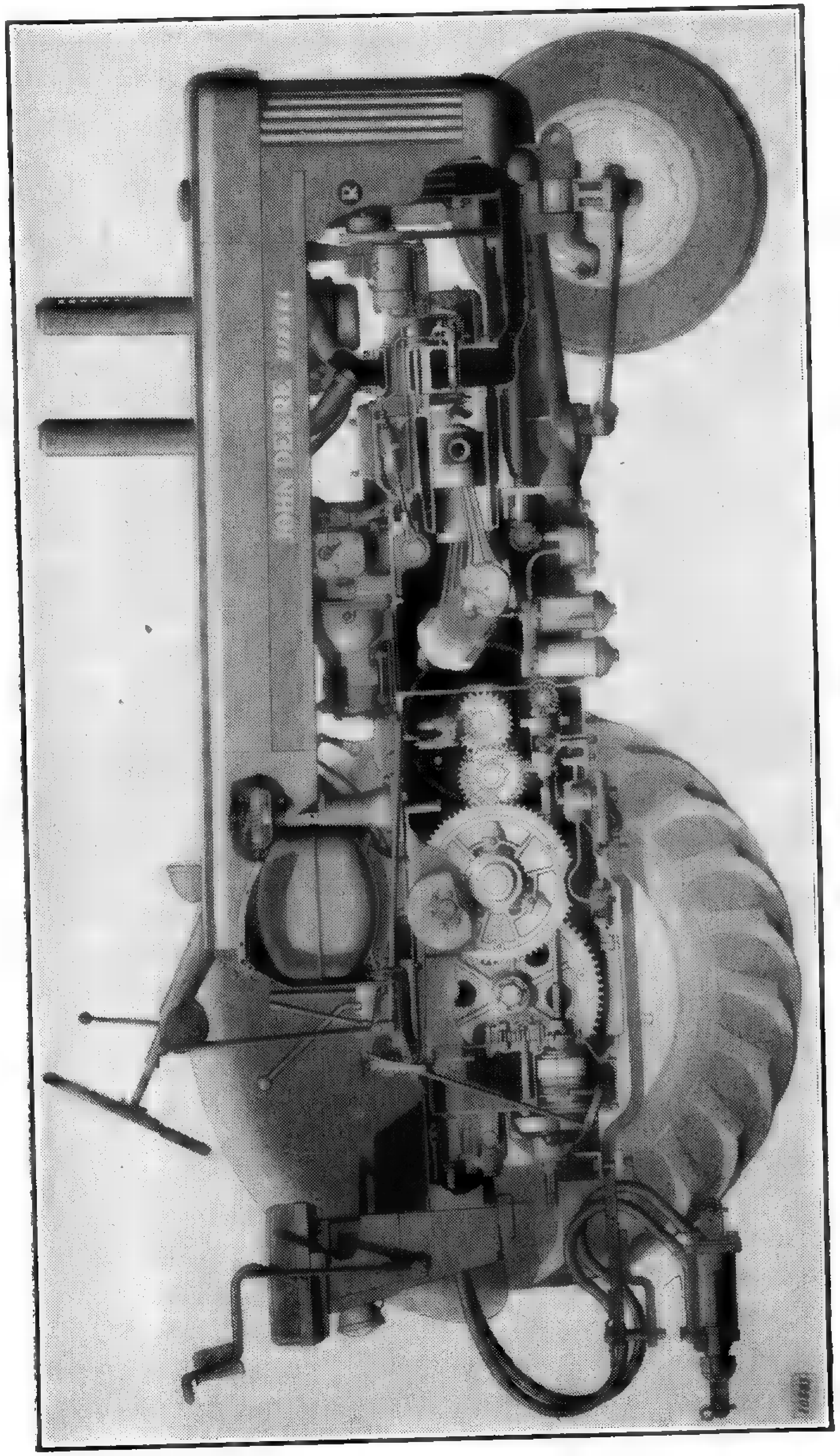


Figure 38—Cross-section view of a Diesel tractor.

might injure the closely fitted parts of the injector pump and injectors.

This system of filters is intended only to remove the dirt and water which may normally enter the fuel tank during tractor operation in the field and the condensation which may form in the tank. Under normal conditions, these filters should not require service too frequently. Follow the recommendations of the manufacturer set forth in the operator's manual.

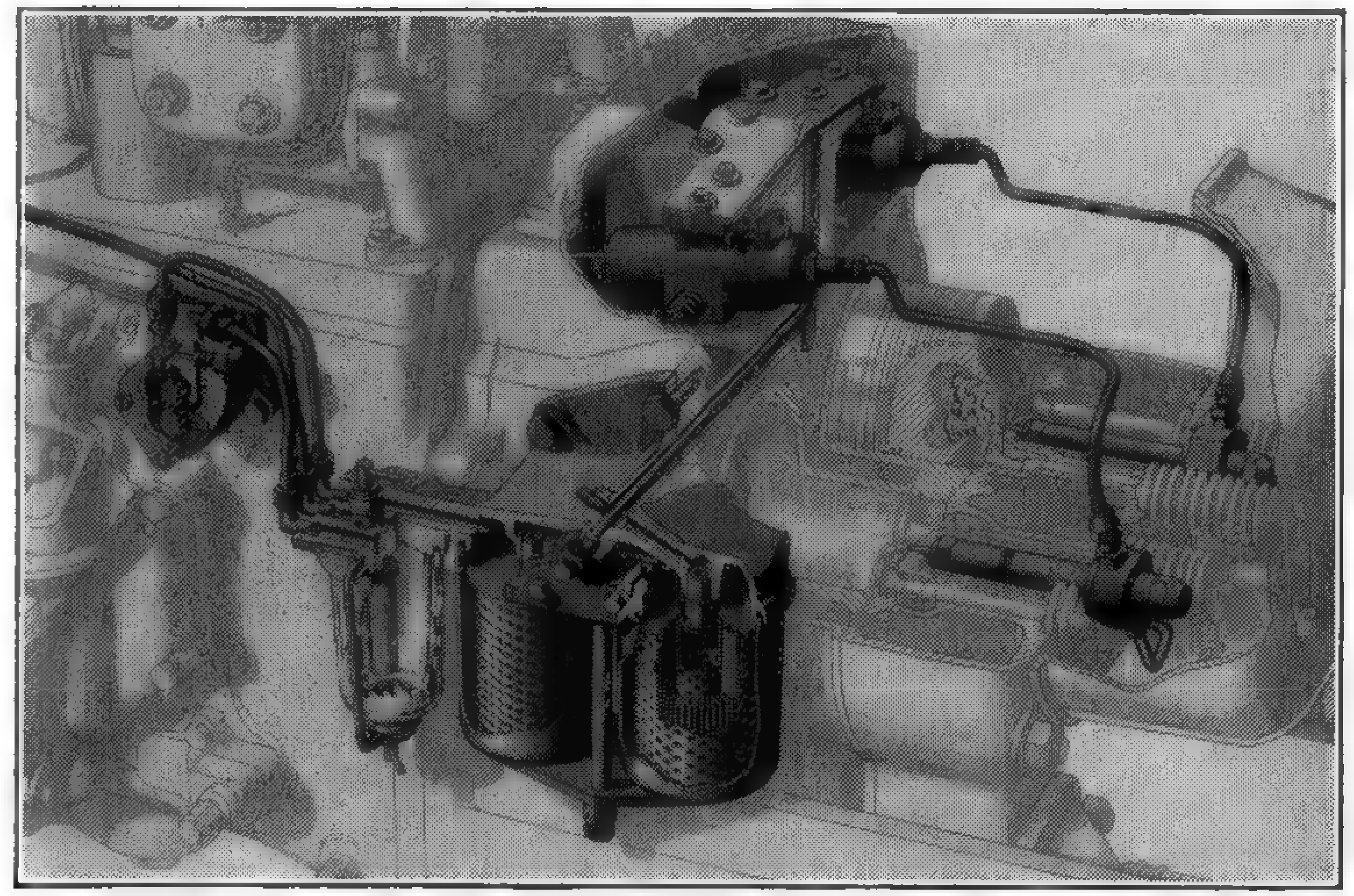


Figure 39—The three-stage fuel filtering system used on one type of Diesel tractor.

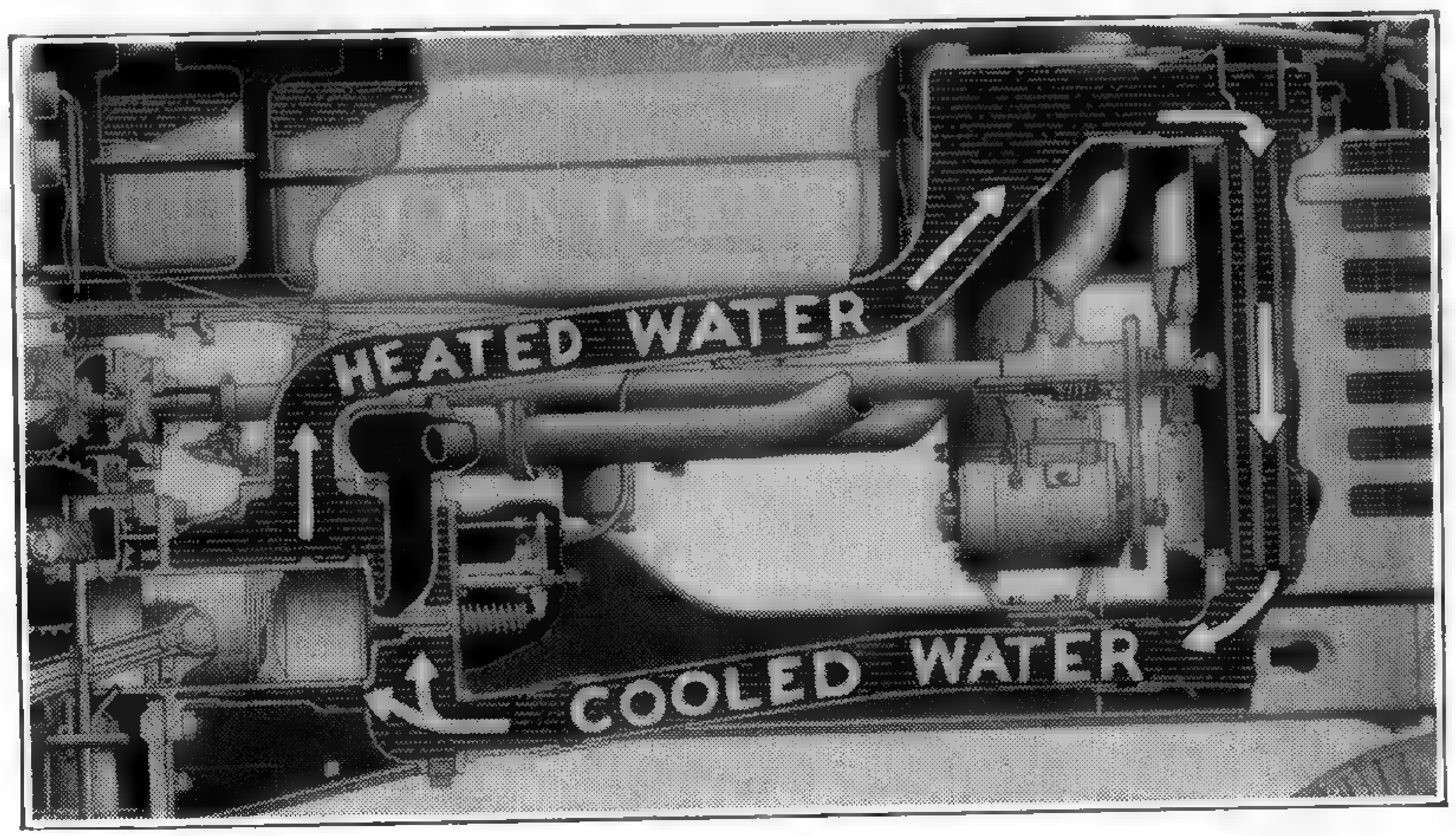
The clean fuel now flows to the injection pumps which force the fuel under high pressure into injection nozzles. The fuel is then broken into a fine mist and sprayed directly into the combustion chamber.

Repairs or adjustments on the injection pump should be made by a competent mechanic in your dealer's shop. On the other hand, injector nozzles can be checked for proper operation, as recommended in the operator's manual.

Diesel Starting Engine. One of the problems in design of the Diesel engine, regardless of size, is the amount of energy required to crank the engine. Obviously very high compression pressure is the reason. Hand cranking is usually out of the question and, in most cases, a mechanical starter is used. In the case of the tractor being discussed, a small, high-speed, two-cylinder engine equipped with electric starter furnishes power for starting the Diesel engine. This small engine is identical in principal to the standard gasoline engine discussed in previous pages.

In starting the Diesel engine, the compression pressure is released. As soon as the Diesel engine is turning over properly the compression release lever is disengaged, the fuel-injector pumps are engaged and firing begins. The auxiliary engine is then disengaged and stopped.

The Cooling System. The purpose of the cooling system, regardless of whether Diesel or spark ignition type of engine, is to dissipate the heat of combustion and friction and to maintain proper engine temperature for most efficient engine performance. When we consider, for example, that the temperature in the combustion chamber of a spark-



Cross-sectional view of the thermo-siphon cooling system.

ignited engine under load may run as high as 1250° F, the need for an adequate, efficient cooling system, properly maintained, is apparent.

The spark-ignition tractor shown in Fig. 21, is cooled by water forced through the system by a water pump. Water is cooled through the radiator by a blast of air drawn through the radiator by the fan. Proper operating temperature is maintained by means of a thermostatically controlled radiator shutter. The water pump provides a constant forced circulation of the water.

The cooling system of the Diesel tractor, discussed previously, and that of many general-purpose tractors is through the thermo-siphon or temperature-controlled system. When the cylinders warm up after starting the engine, the warmed water rises and is displaced by cooler water. The constantly rising warm water from around the cylinders causes a circulation through the radiator where the water is cooled.

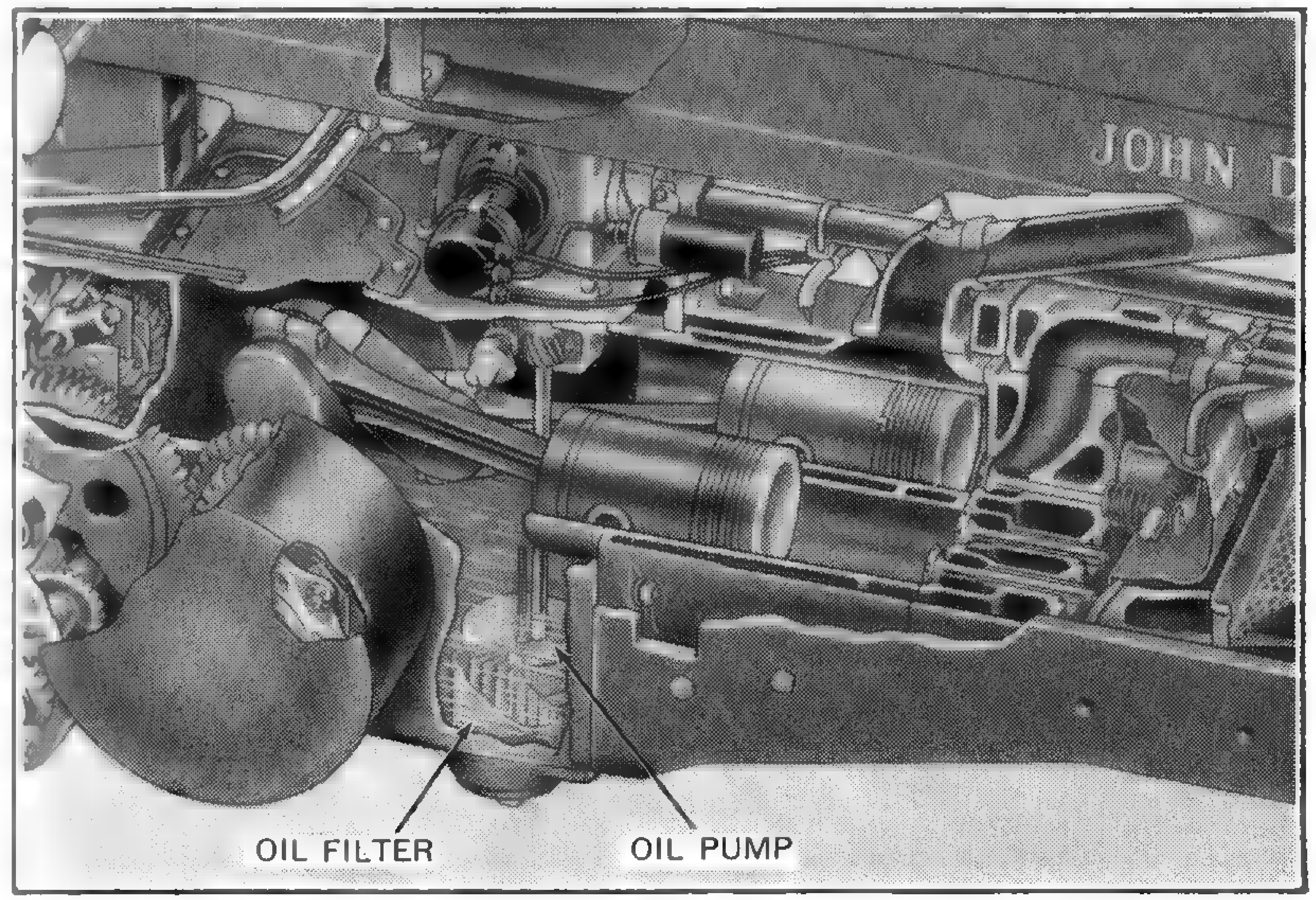


Figure 40—Horizontal cross-section showing oiling system.

The radiator consists mainly of a core of vertical tubes attached to which are fins that form extra cooling area. As the fan draws a steady current of air through the radiator, the water is cooled as it flows downward or is forced through.

While the manufacturers of most tractors provide screens to prevent foreign matter from entering and clogging the radiator tubes, it is the operator's responsibility to see that this screen is kept clean. Make certain that only clean water is placed in the radiator and that the water level is always above the radiator tubes. Extremes of temperature may cause serious damage to the tractor. Water should never be poured into an empty cooling system when the engine is hot, nor should cold water be poured into a hot

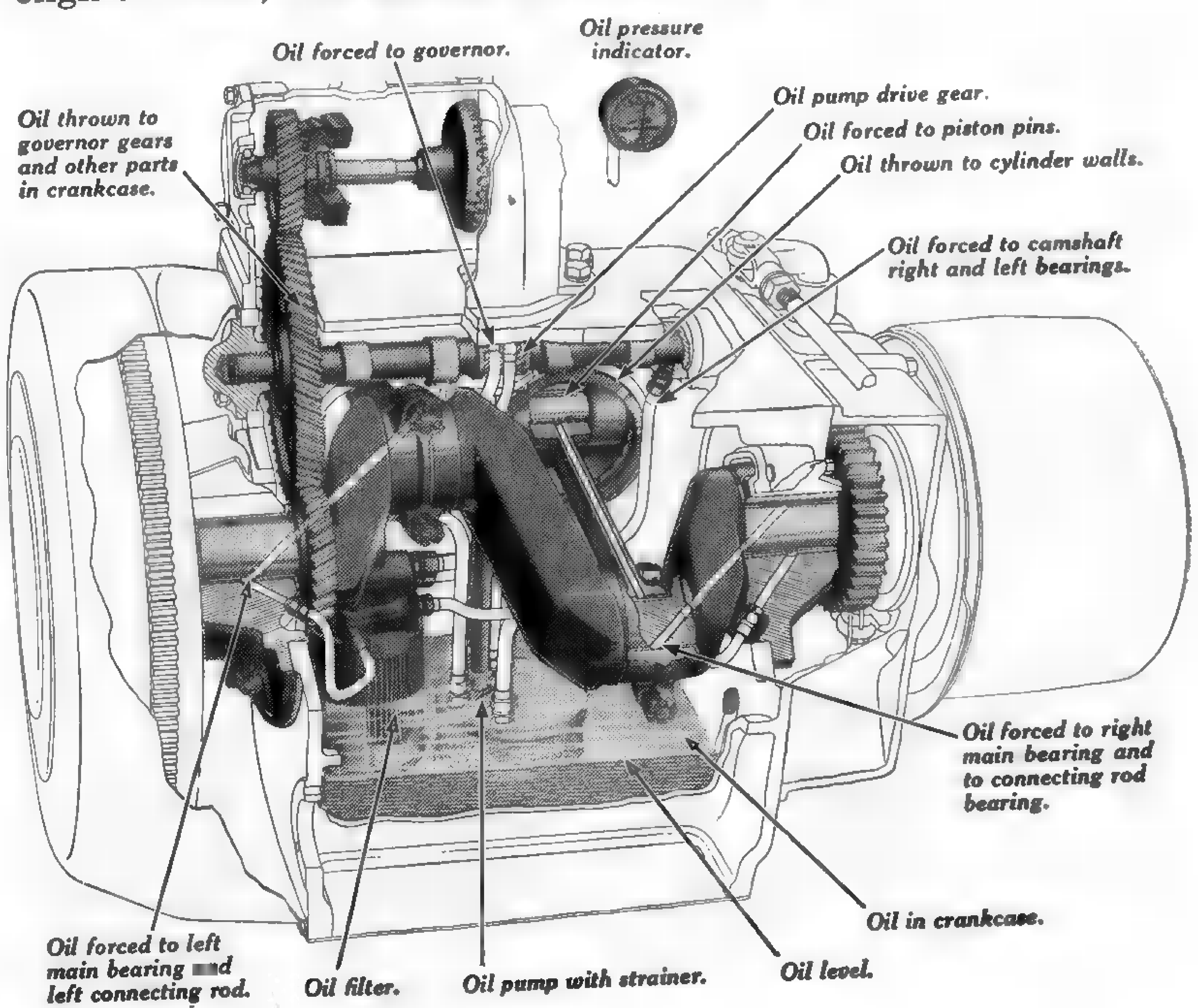


Figure 41—Cross-section of the oiling system showing how all working parts are automatically oiled.

engine, or hot water poured into a cold engine. Many cooling systems today are designed to operate under pressure. Since a sudden release of pressure may result in scalding of the operator, it is recommended, as a safety procedure, that the tractor be permitted to cool before the radiator filler cap is removed.

The Oiling System. Of all farm machines, the tractor requires the most careful oiling. Due to the nature of its work and the large amount of friction surface in its bearings and cylinders, the tractor must be properly lubricated with good oil and grease if it is to develop its maximum efficiency and last a normal length of time. No other factor affects the life of a tractor so greatly as does oiling.

Engine lubrication is of special importance, for engine parts are built to fine precision, many parts being held to tolerances as close as one-thousandth of an inch. Close tolerances generate considerable heat of friction which must be dissipated or conducted away. Add to the heat of friction, heat generated by combustion and we have a three-fold reason why engine lubrication should be given exacting consideration.

The engine of the general-purpose tractor shown, is provided with a positive-driven, full-force-feed pressure lubricating system. A gear-type oil pump forces oil under pressure through the replaceable oil filter element, into the main bearings and through the drilled crankshaft to the connecting rod bearings, then through holes in connecting rods to piston pins (see Fig. 41).

When the engine is started, the oil indicator (see Fig. 41) will show pressure if the oiling system is working properly. If it does not show pressure, the operator should check the supply of oil in the crankcase. If the oil level is correct, the trouble may be in the oil strainer screen or in the pressure relief valve. Another possibility is that the oil gauge itself may not be functioning properly, in which case the gauge should be checked with a master gauge by your implement

dealer. To insure lubrication, the indicator must show pressure when engine is running.

After every ten hours of operation, the level of oil in the crankcase should be checked and fresh oil added if necessary. After every 120 hours of operation, the crankcase should be drained completely and refilled with fresh oil of proper weight or viscosity for the temperature range in which the tractor will be called upon to operate (see Fig. 42). Oil of the wrong weight can result in loss of power, excessive fuel consumption, and undue wear on moving parts.

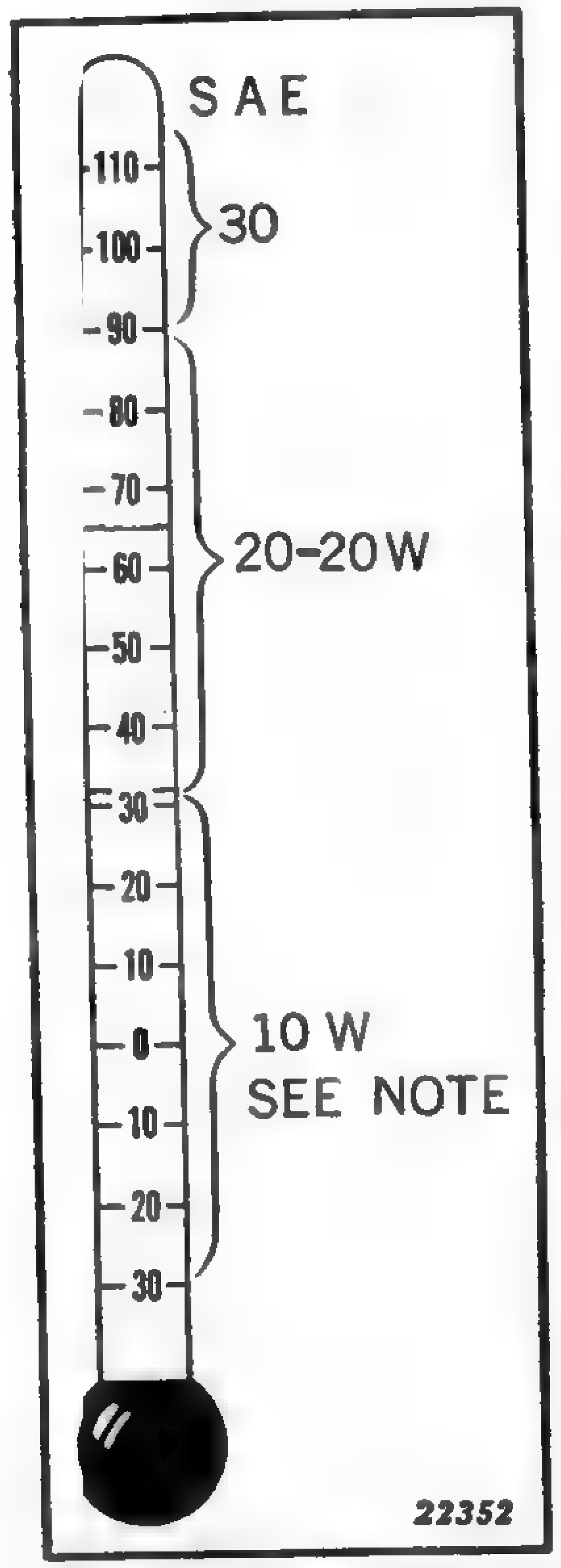


Figure 42—Chart indicating correct weights of oil to use at various outdoor temperatures.

At the time the crankcase oil is replaced or changed, the replaceable filter element should be removed and a new element installed. (See Fig. 43). The importance of the filter cannot be overestimated. The modern tractor engine, built to close tolerances as mentioned previously, can be seriously damaged by grit particles as small as one-thousandth of an inch. For this reason, the filter element is designed to remove these tiny particles. However, when the filter element becomes clogged with grit, it cannot permit the further passage of oil. Grit-laden oil, then, is by-passed through the pressure relief valve to the bearings, pistons, rings, and other precision parts.

A mistaken idea, prevalent among some tractor operators, that *clear* oil is *clean* oil has resulted in serious damage to many a fine tractor engine. Here is a test that you can make in the classroom or at home: fill a test tube with clear oil; add a teaspoonful of clean sand; shake the tube. The oil remains clear, the grit will settle, but the clear oil is laden with abrasive particles which, if placed into a crankcase, would bring destruction to bearings in a short time. The same test proves the fallacy of the idea that if oil "feels" good, it is safe oil for the crankcase, for when the engine is stopped, the heavy grit particles settle to the bottom far from the check cock and out of reach of the dip stick.

Clear oil is not always *clean* oil; likewise *dark* or *black* oil is not necessarily *dirty* oil. When oil becomes dark or discolored in service, the discoloration is due primarily to the entry of soft carbon which, in itself, is a lubricant.

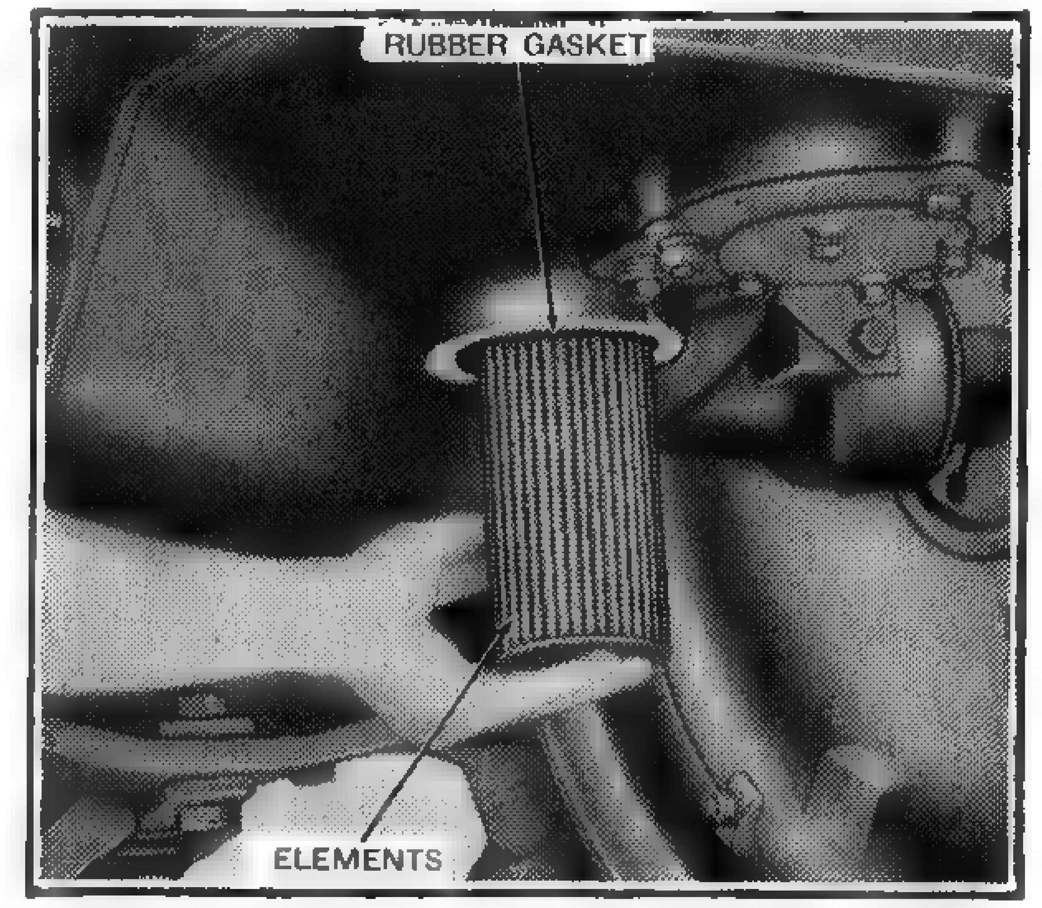


Figure 43—Oil filter should be changed at least every 120 hours of operation.

The present-day heavy-duty oils are proof of the point established in the preceding paragraph. The modern heavy-duty oils enter the crankcase just as clear as the regular type oils, yet, upon draining, they will be discolored, in many cases, actually black. These oils have the faculty for carrying particles in suspension to be drained out with the used oil rather than to drop into the crankcase to foul the clean oil replacing it.

From the foregoing paragraphs, it is obvious that we cannot depend upon our eyes or our fingers to judge the condition of the oil; therefore, it is the part of true wisdom to follow the manufacturer's instructions for periodic changes of oil and filter elements. When replacement of filter element is indicated, it is of greatest importance that the replacement unit be of the size and type recommended by the manufacturer of your particular tractor.

The Ventilating System. The tractors discussed on previous pages are equipped with automatic crankcase ventilation systems. This means a constant circulation of clean air is drawn through the air cleaner and through the crankcase.

The illustration, Fig. 44, shows how this automatic ventilation system works on the general-purpose tractors. Air that has been cleaned by passing through the air cleaner is drawn through a pipe, tapped in the air inlet elbow, and forced into the crankcase by a rotor pump. The air circulates throughout the crankcase, collecting harmful vapors and is then expelled out through a vent ahead of the tappet case cover. This ventilating system, as mentioned, is entirely automatic.

The air cleaner system and its care were discussed thoroughly on page 24.

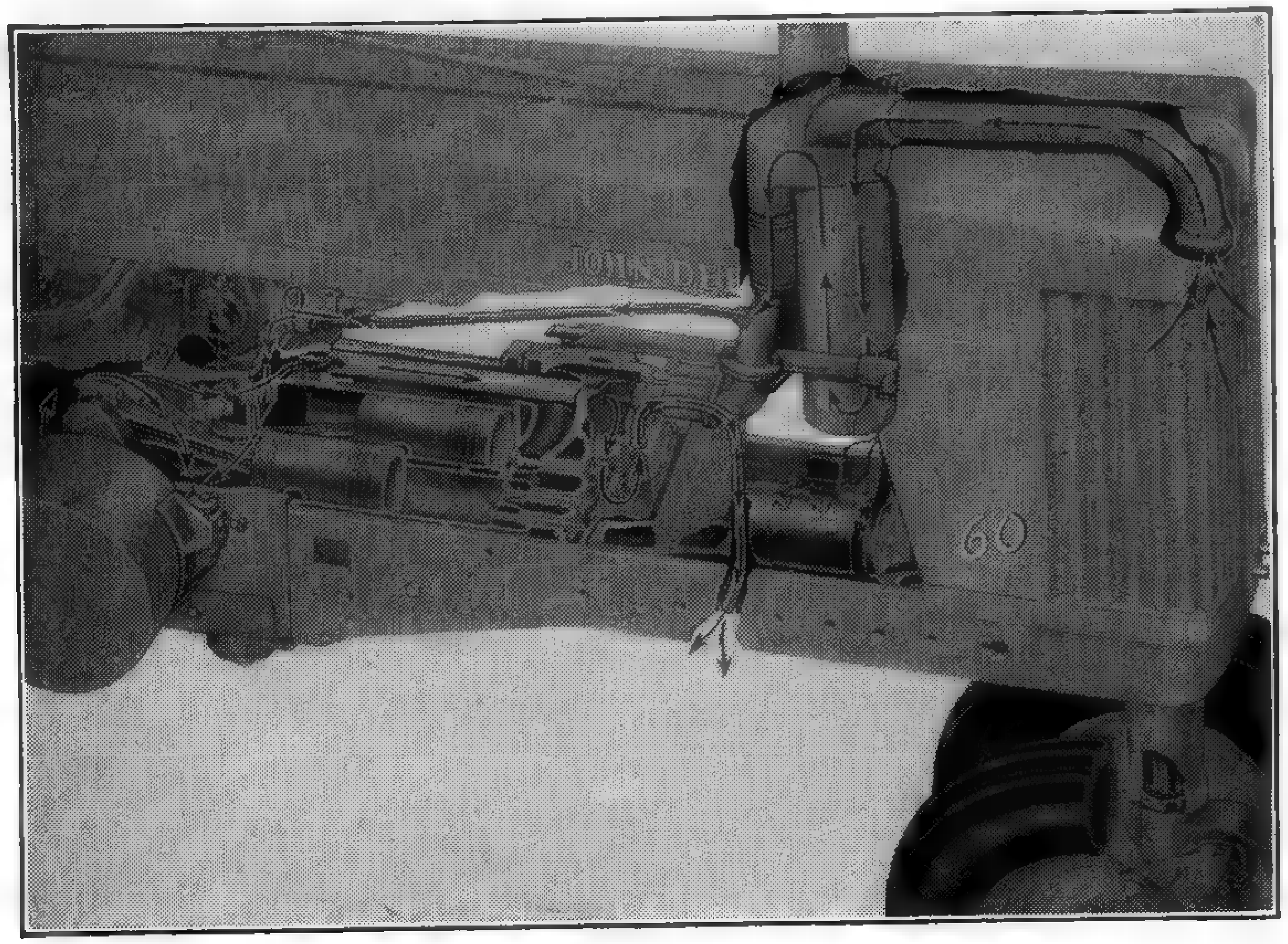


Figure 44—Cross-section of the crankcase ventilation system.

Transmission System. The transmission system, as its name implies, transmits or delivers the power from the engine to the drive wheels where it is used to pull loads; to the power take-off where it is available to operate equipment requiring power in addition to that necessary for forward travel; and to the power lift, where it is used in raising and lowering integral equipment and, with remote cylinder, for raising, lowering, and adjusting drawn equipment. Power is transmitted to the belt pulley direct.

Power is transmitted from the engine to the drawbar through the clutch and transmission gears and through the final drive or differential to the axles. Sliding pinions of varying sizes in the transmission are shifted to mesh with corresponding gears to provide for various tractor speeds forward and one speed in reverse as mentioned.

A differential is a special arrangement of gears which permits each drive wheel to turn independently as the tractor turns a corner. It permits one drive wheel to rotate slower or faster than the other when turning or when working in rough conditions.

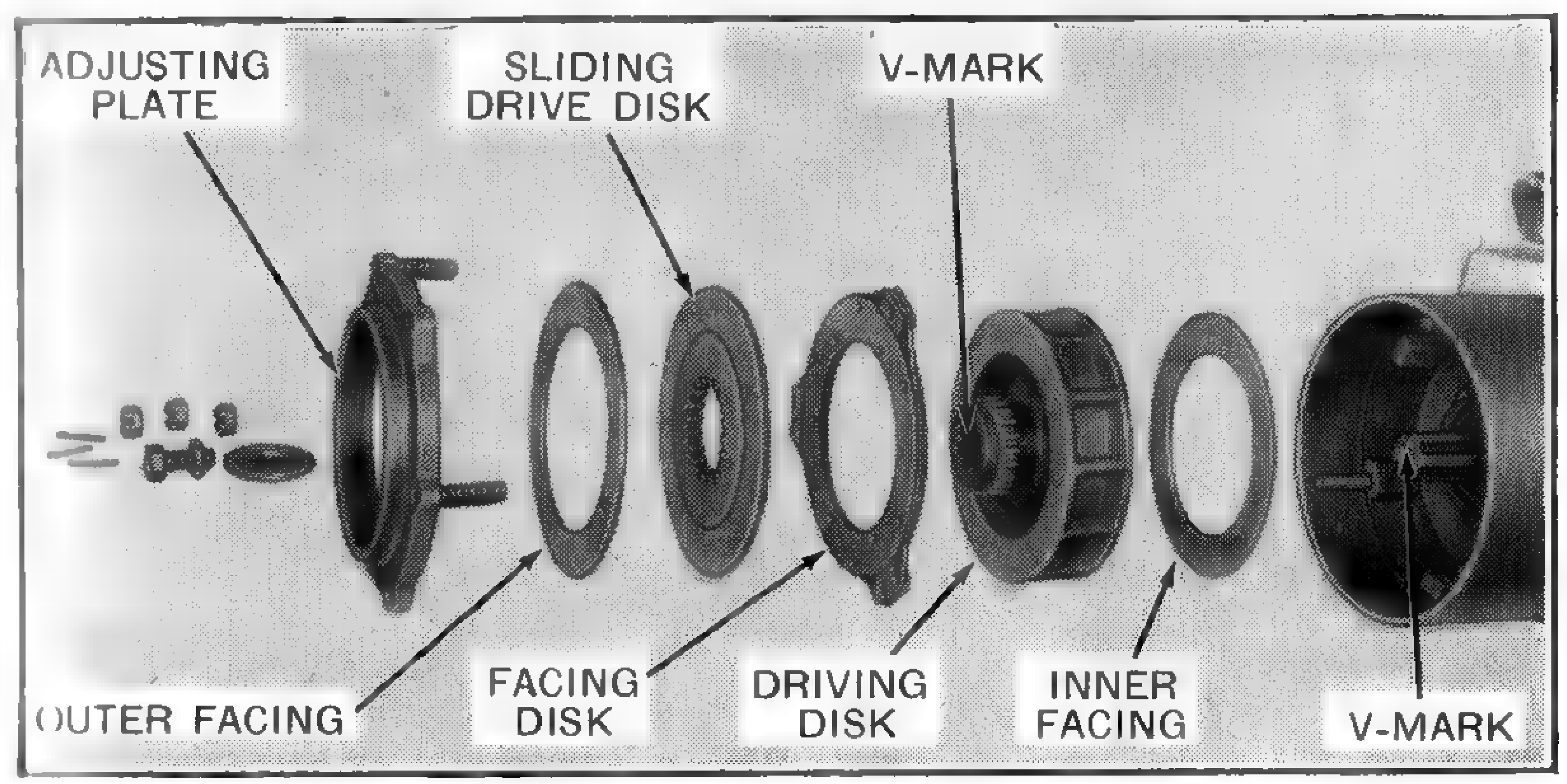


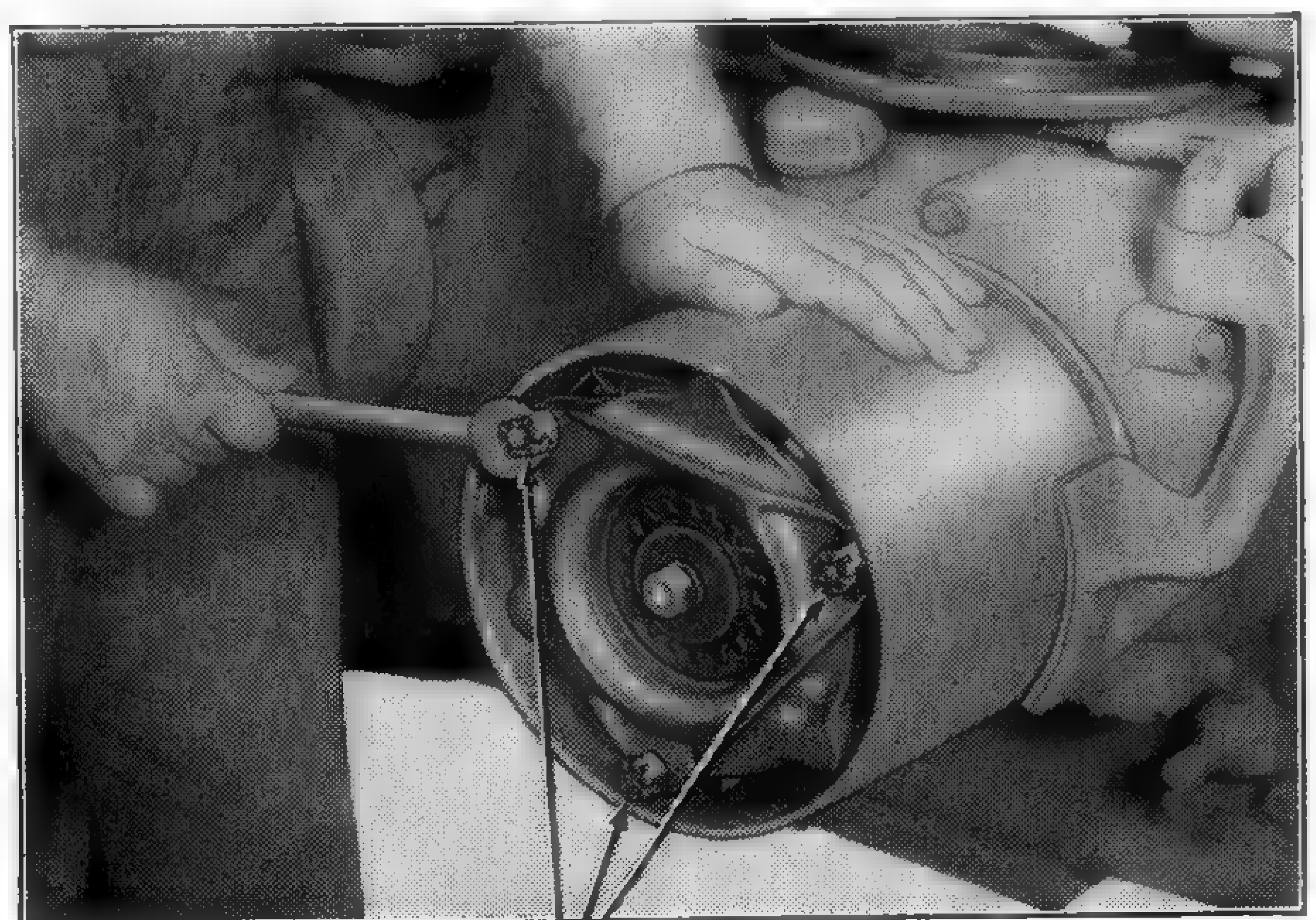
Figure 45—Clutch "exploded" to show principal parts.

The sole purpose of the clutch (Fig. 45) is to link or connect the power of the engine to the load. Without such a link, no provision could be made for transmission of power to the various power outlets or for changing speeds or direction of travel. To function properly, the clutch should engage smoothly, picking up the load gradually rather than with a jerk.

The clutch on the tractor used for this text, is properly adjusted when the nuts are drawn up exactly to the same tension, and the clutch operates with a snap, requiring some pressure to lock it. If it is necessary to tighten the clutch, each nut must be turned down to the same tension, disregarding the number of exposed threads (see Fig. 46).

To replace clutch facings, remove dust cover and clutch adjusting plate (see Fig. 45).

When installing new clutch facings, make certain that the inside or first clutch facing is in proper position while clutch drive disk is being replaced. Install second clutch facing in clutch adjusting plate, making sure to have the



Clutch Adjusting Nuts

Figure 46—The clutch is adjusted properly when all nuts are drawn up to [redacted] tension.

three short springs in place. Adjust clutch as described. Always refer to the operator's manual for proper directions in servicing the clutch on your particular tractor.

Lubrication of Transmission. The transmission and differential units require little attention other than efficient lubrication which is highly important.

In the enclosed transmission and differential, gears, shafts and bearings operate in a bath of heavy oil. For proper lubrication of these parts, the correct oil level should be maintained. Periodic check, following the manufacturer's instructions, will determine when oil should be added. Seasonal change in weight of oil used in transmission and differential, in line with the manufacturer's instructions, is necessary for efficient operation and long life.

The heavy gears in transmission and differential depend upon a cushion of oil to relieve the tremendous shock of starting and the constant pressure of working under load. Too thin or light an oil will be "squeezed" out by the teeth; too heavy an oil will not be carried around by the gears. A simple test to prove this point is to run a cold gear over a heavy grease—note that the gear simply makes a print or track in the grease without picking it up.

In addition to the engine, transmission, and differential units, there are several oil fittings that require regular attention with a high-pressure grease gun. A thoroughly lubricated tractor will last longer and give better service than one that is given only ordinary care.

Power Shaft or Take-Off. A power shaft or take-off is a third means of taking power from the tractor engine to drive such machinery as the combine, baler, and corn picker. It drives the entire mechanism of this type of machine, the wheels acting merely as supporting or carrying members.

The power take-off consists mainly of a shaft, extending back from the tractor, which is driven by the regular trans-

mission. Its operation is controlled by a shift lever usually placed for convenience of the tractor operator.

Hitch and power take-off locations on all general-purpose tractors are now standardized so that tractor-drawn equipment, powered through the take-off, is readily interchangeable, thereby saving the operator considerable time and labor in shifting from one machine to another. It is wise, therefore, when buying new equipment for use with older tractors which do not have standardized hitch and power take-off, to convert the tractor to standard rather than to buy the new equipment with parts to adapt it to the old tractor. In this way, your power equipment will be adapted to your present tractor and to the new tractor you may acquire later. Your implement dealer will offer further information at the time you purchase equipment.

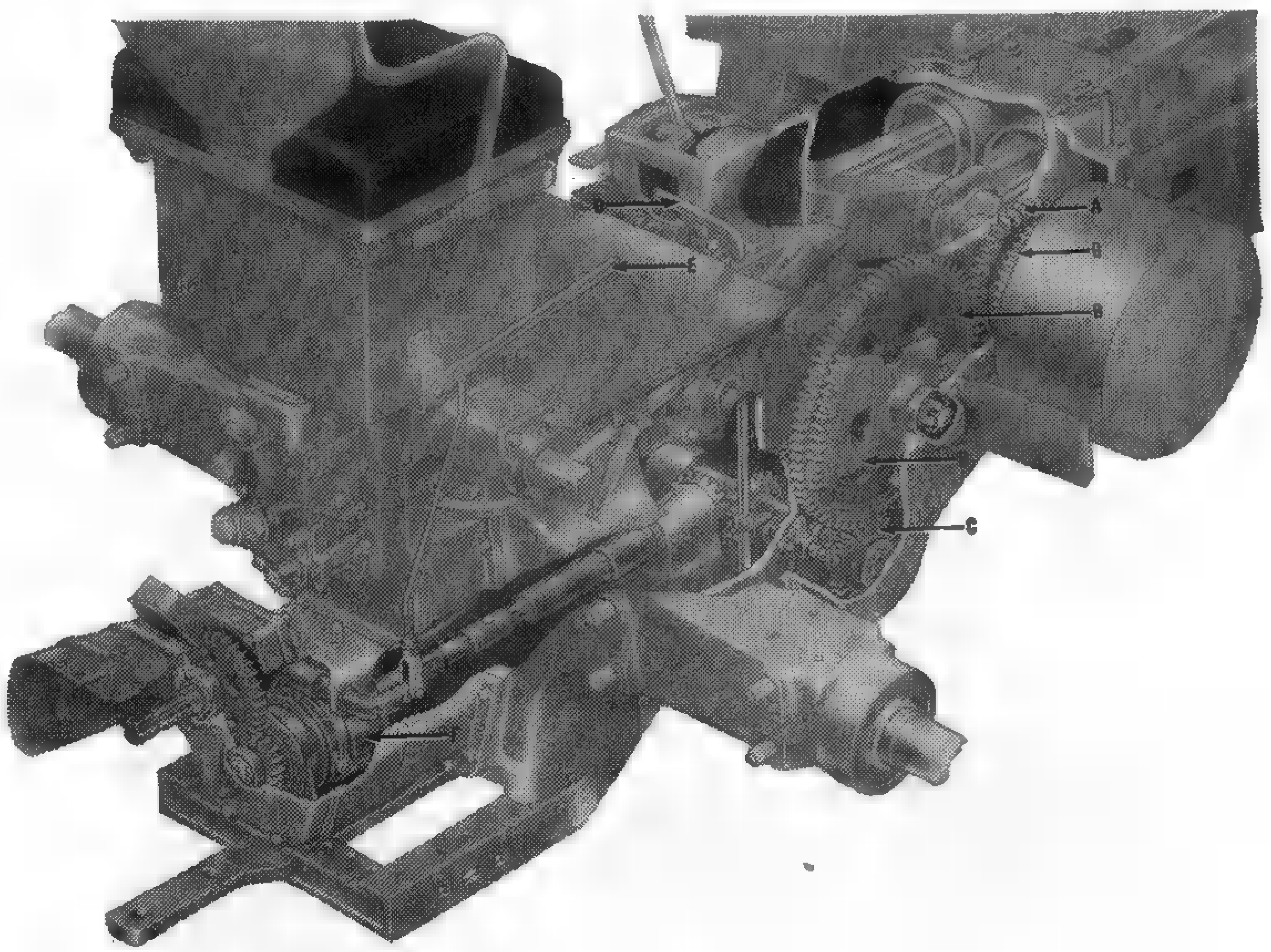


Figure 47—This tractor has been cut away to show the power take-off power train. Sliding gears and drive shafts operate in oil. (A) power shaft idler drive gear; (B) power shaft idler gear; (C) sliding gear and shaft; (D) shifting lever for sliding gear and shaft; (E) power shaft clutch lever; (F) power shaft clutch; (G) belt pulley gear and (H) first reduction gear.

"Live" Power Shaft. The general-purpose tractor described on previous pages is equipped with a "live" power shaft. (See Fig. 47.) It provides continuous running power for operating power take-off machines as long as the tractor engine is running. Its power is completely independent of the transmission clutch. The operator can stop the forward travel of the tractor at any time and start it up again while the power-driven machine continues to operate at full speed without interruption. This is especially advantageous in harvesting heavy crops with a minimum of loss.

On the tractor shown in Fig. 47, power is delivered directly from a drive gear on the crankshaft to an idler gear. Both gears operate whenever the engine is running. A sliding gear and shaft transmit power through the power train to a spring-loaded, over-center, wet-disk type clutch. Engaging the clutch delivers power to the splined PTO shaft which drives the equipment.

This clutch enables the operator to bring the power-driven implement up to full speed before starting the forward movement of the tractor. It completely protects the PTO shaft and cushions shock on the implement. Even when with the engine at wide open throttle, the clutch can be engaged instantly without damage. The power shaft clutch has an independent oil reservoir and lubrication system; it operates in a constant bath of oil supplied by a separate pump.

Operator's manual should be consulted for proper servicing.

Differential Brakes. The foot-operated or rear wheel differential brakes, one for each drive wheel, are provided to facilitate short turning either right or left when working in row crops, to stop the tractor, and to hold the tractor stationary on belt work.

In operation several cautions should be used in applying differential brakes: when traveling at high speed as on

highways or in going to and from fields, brakes should be applied gradually and uniformly to both wheels to prevent skidding of the tractor and, in extreme cases, upsetting. Never brake one wheel when turning at high speed. Observe, always, that brakes are provided solely for the purposes outlined above.

Differential brakes require only occasional adjustment which should be made in accordance with instructions given in manufacturer's service manual or instruction book.

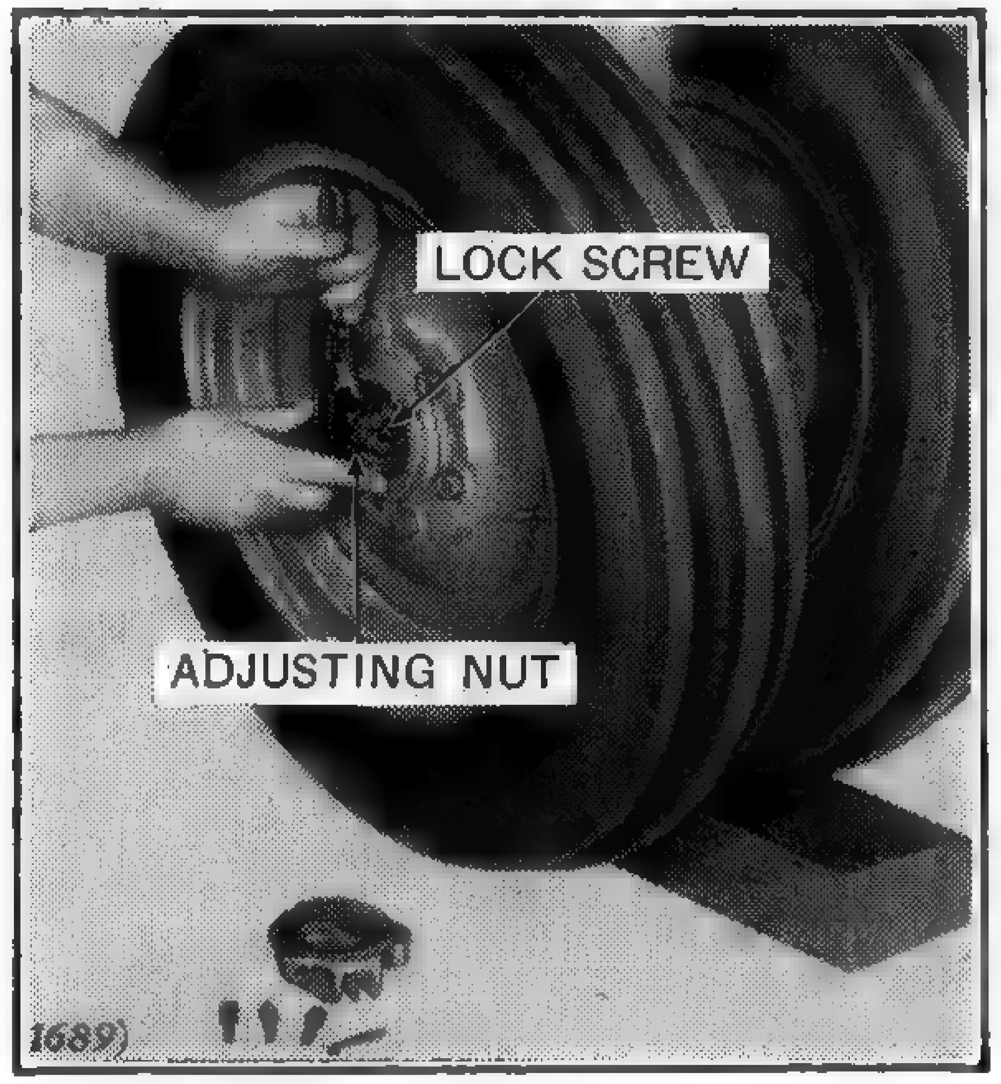


Figure 48—Front wheel bearings should be checked for proper adjustment.

Whenever a brake adjustment will not correct or improve defective brake action, the brakes should be relined.

Lubrication of Front Wheel Bearings. Lubrication and adjustment of front wheel bearings should be given special attention. While the front wheels on most tractors are lubricated by means of a high-pressure fitting, it is advisable to remove the wheels for occasional servicing.

To service front wheel, remove the wheel, take out all old grease, examine the bearings (Figs. 48 and 49), clean the two felt washers in gasoline, resoaking in transmission oil before replacing. If these washers are worn thin, replace with new ones. Pack hub and bearing with wheel bearing grease, replace wheel on spindle, and adjust as follows: relieve bearings of all weight by running one wheel up on a block or plank to raise the other. Turn adjusting nut tight; then, back off the adjusting nut 1/3 to 1/2 turn. Adjust opposite wheel in same manner. Wheels should

rotate freely but without end-play. Lock adjusting nut at proper point.

Front wheels of many general-purpose tractors may be reversed as shown in Fig. 50, to provide easier steering control, especially in listed crop territories where it is necessary to keep the front wheels on the ridges. This extra clearance is an advantage in exceptionally muddy conditions, since mud will not accumulate under the frame. In normal conditions, steering is easiest with the wheels in narrow setting.

Another important aid to easy steering, operator comfort, and increased tire life is the load equalizer (Fig. 10), which equalizes the front end load over both wheels, permitting the tractor to "walk over" surface irregularities and to conform with ridges in the field. Riding is greatly improved because up and down movement of the front end is cut exactly in half as the tractor travels over rough ground.

Hydraulic Power Control. This control supplies power for raising and lowering integral equipment through the tractor rockshafts and for making field adjustments of drawn equipment through a remote cylinder attached to the implement and connected to the tractor by flexible oil lines. Both rockshafts and remote cylinder are actuated by one lever.

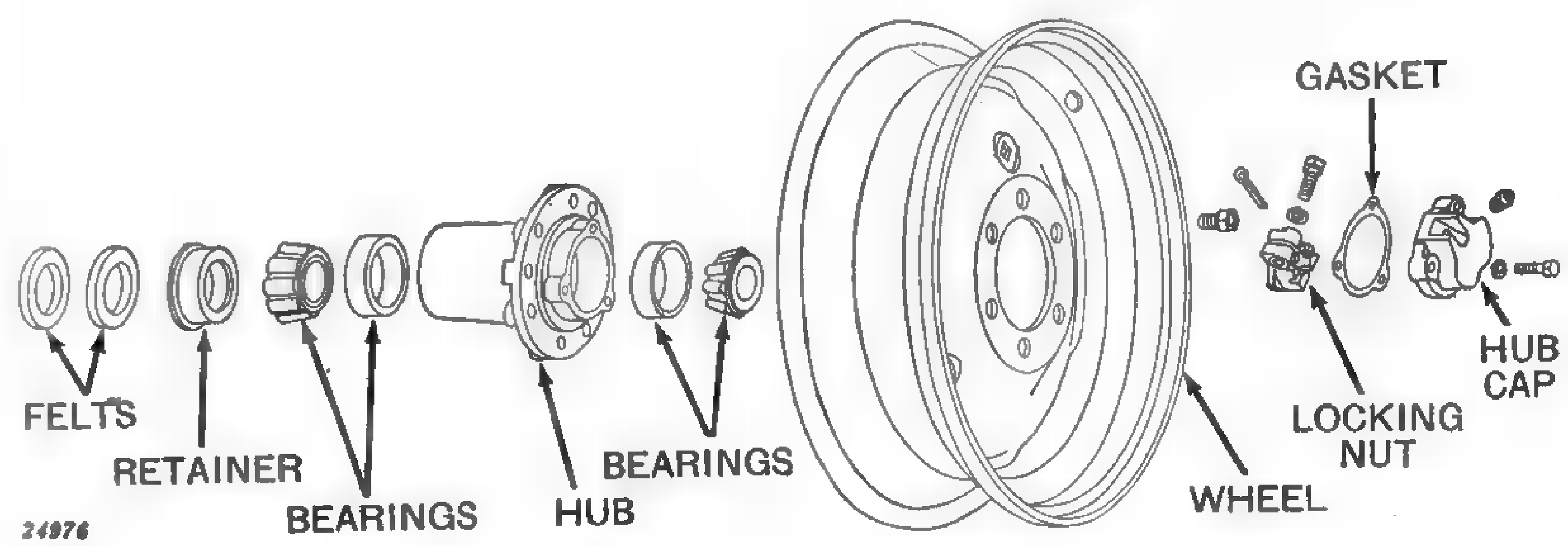


Figure 49—"Exploded" view of front wheel bearings and related parts.

The tractor shown in Fig. 21 can be equipped with "live" high-pressure hydraulic control which is direct engine-driven and operates completely independently of both the transmission clutch and the power take-off. Power is taken from the crankshaft gear and transmitted to the hydraulic control pump through the cam gear and idler gear. (See Fig. 51.) Whenever the engine is running the hydraulic power is available to the operator.

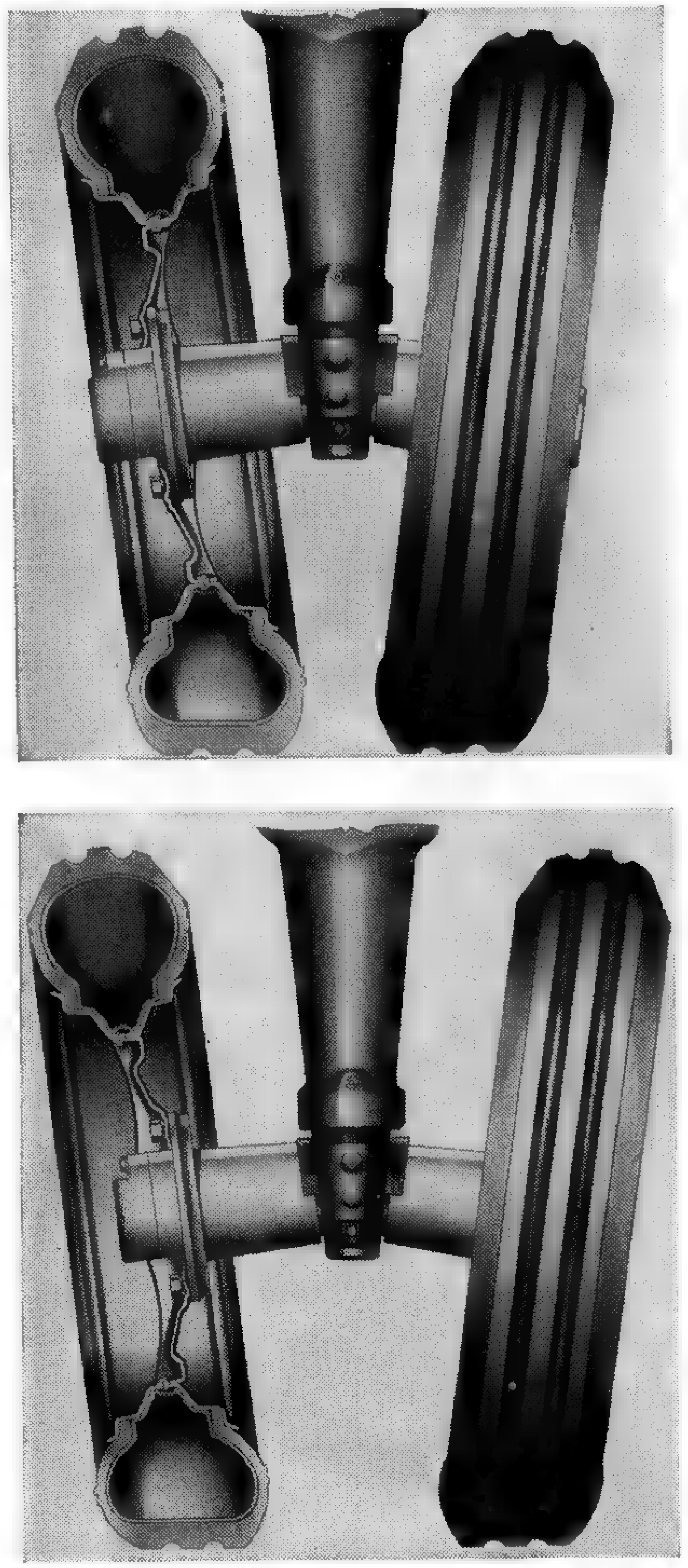


Figure 50—Front wheels set in normal position (top) and in wide setting as used on listed ridges or for easier steering in muddy conditions.

When the hydraulic power is used for remote cylinder operation (see Figs. 52 and 53), the power can be used to regulate and adjust drawn equipment. With this valuable extension of power, the height of the combine platform, for example, may be raised or lowered quickly, easily, and exactly to meet varying conditions; the plow may be raised just enough to pass over a bad spot in the field; the disk harrow may be straightened to cross a grassed waterway and angled quickly returning to work at the pre-set working angle.

Any degree of variation within the extreme limits set by the operator may be gained, simply by moving the control lever in the selective range, yet, when the lever is moved quickly to either extreme, the maximum lift or drop is obtained promptly.

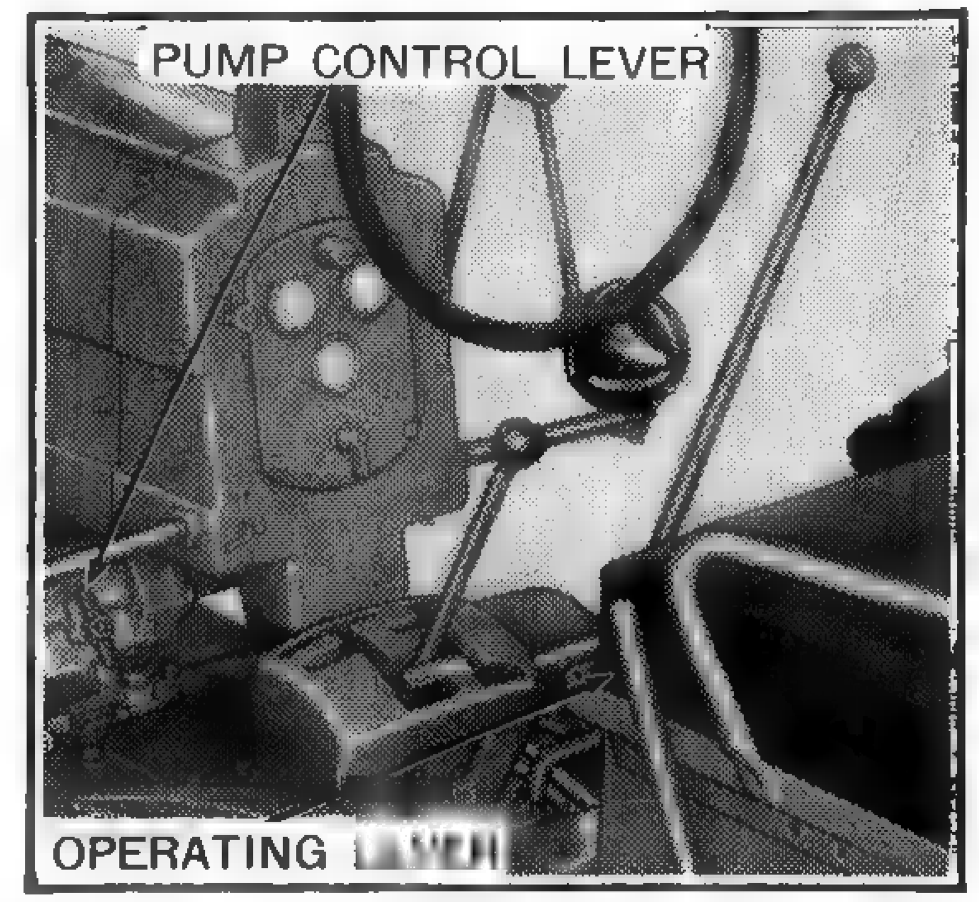


Figure 51—Hydraulic power pump control engaged through the control leader. Operating lever has five operating positions; neutral, slow raise, fast raise, slow drop, and fast drop.

In making the simple change from rockshaft operation to remote cylinder control of drawn equipment, several basic considerations should be remembered. While the piston in the remote cylinder operates on a reciprocal motion, powered on both the outward and inward strokes, the cylinder should be placed so that the lifting load is always applied on the outward stroke, thereby taking advantage of the full area of the piston for the heavier load.

In coupling the oil lines to the tractor, knurled coupling adapter rings should be drawn up snugly by hand only—never with a wrench.

Since valve openings, or apertures, are extremely small—many of them smaller than the lead in a fine-line pencil—it is of utmost importance that dirt and other foreign

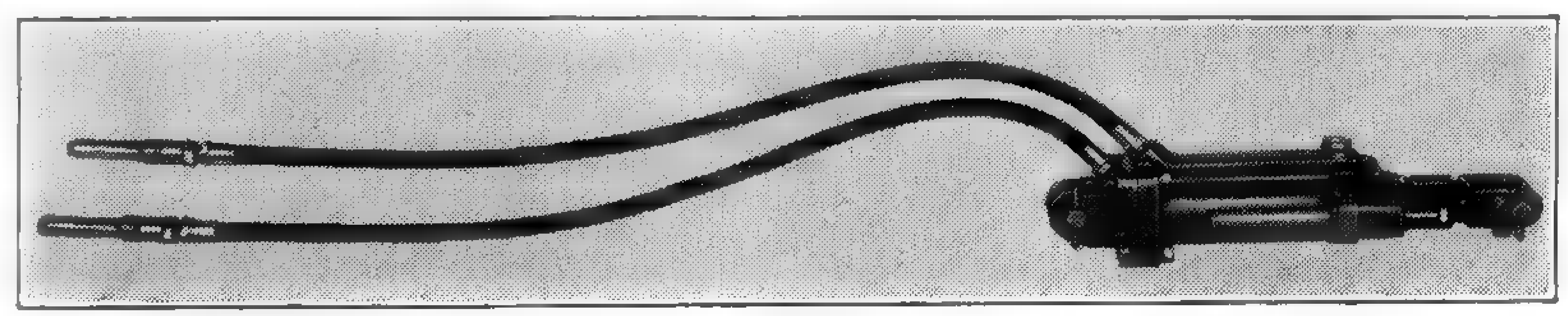


Figure 52—Remote cylinder complete with hydraulic hose. Fittings are capped to protect from dust and dirt.

matter are kept out of the system. The manufacturer has provided every protection possible, yet it is the operator's responsibility to use extreme care in keeping the system clean.

The hydraulic unit requires very little servicing other than a periodic check for proper oil level. Change oil twice a year, preferably before spring and winter seasons. The entire unit should be drained and refilled to proper level with the correct grade of oil. When storing the remote cylinder, the piston should be pushed all the way into the cylinder to protect the polished shaft from exposure to dust and moisture.

Hour Meter. The engine hour meter, available in various types, enables you to take the "guesswork" out of servicing your tractor (see Fig. 54). It keeps an accurate account

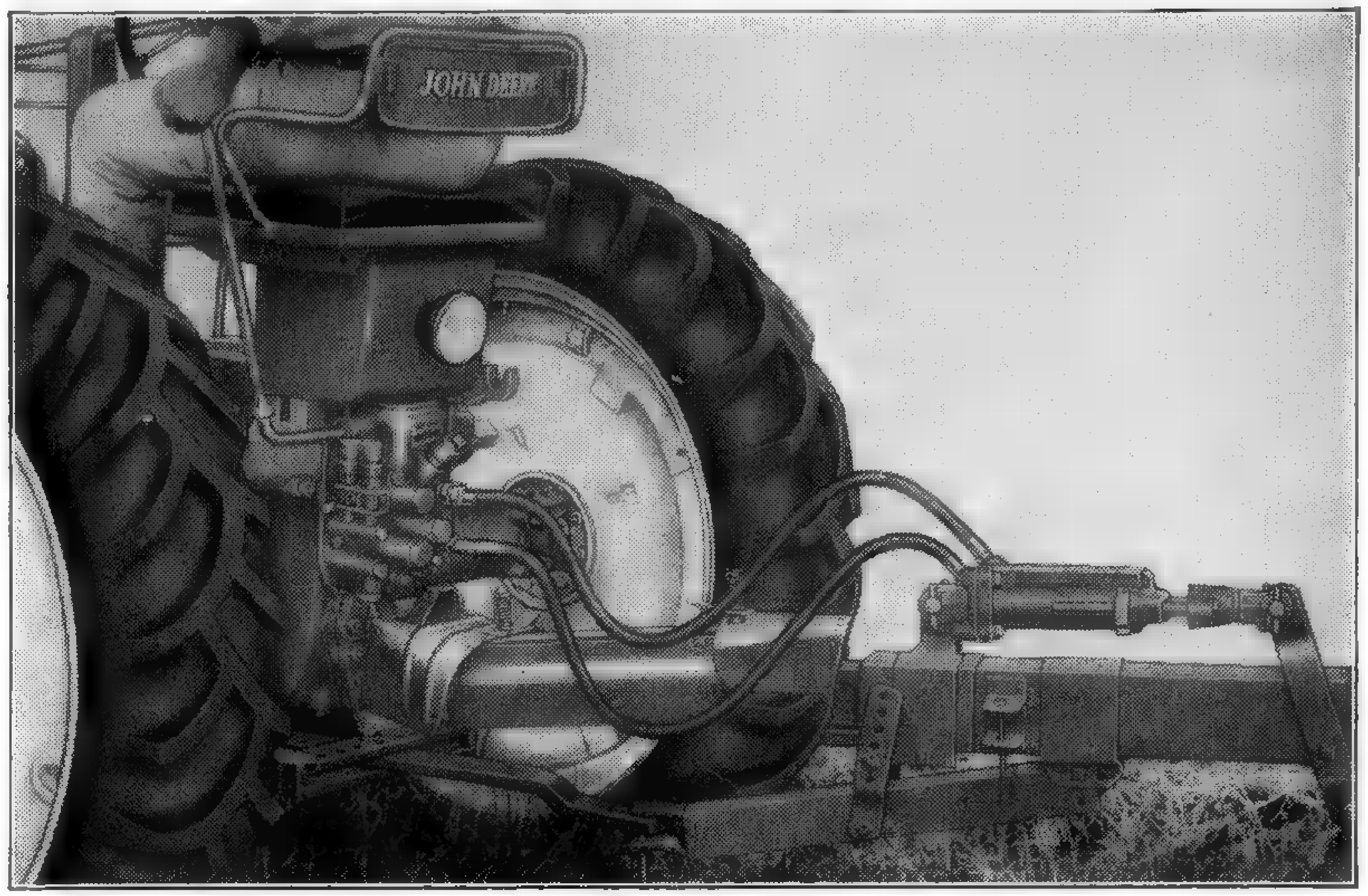


Figure 53—Power lift equipped for remote cylinder operation with hydraulic cylinder connections in position.

of the engine operating time. You protect vital parts of your tractor by lubricating "on schedule" instead of by guesses of hours or days of work. You can change oil exactly at 120 hours as recommended, replace the oil filter, service air cleaner, hydraulic system, transmission and steering at the proper time, giving full preventive maintenance care to your tractor.

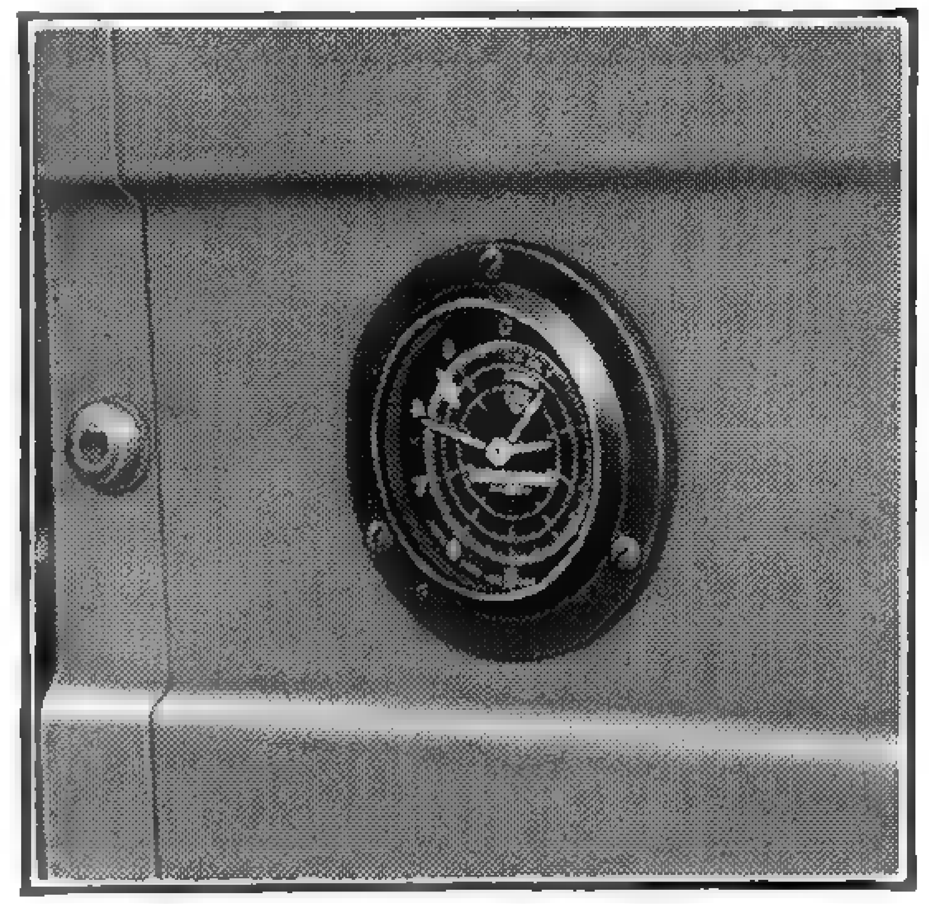


Figure 54—The engine hour meter.

Maintenance of Rubber Tires. The broad use of rubber tires on farm tractors and machinery has resulted in a great saving both in time and operating cost. There are, however, certain basic fundamentals in the care of tires that should be followed carefully if the owner is to derive maximum benefit from his investment.

First and most important is to maintain proper pressure for the work at hand. Your best guide to proper inflation is the instruction book covering the particular tractor or implement under consideration. Read your instruction book or consult your dealer concerning proper inflation, and *check air pressure regularly.* Underinflated tires suffer from rim bruises, sidewall snagging, and carcass failure. Overinflation increases tread wear (on tractors and ground-driven implements) and because of reduced traction, weakens the carcass, and hastens weather checking. An

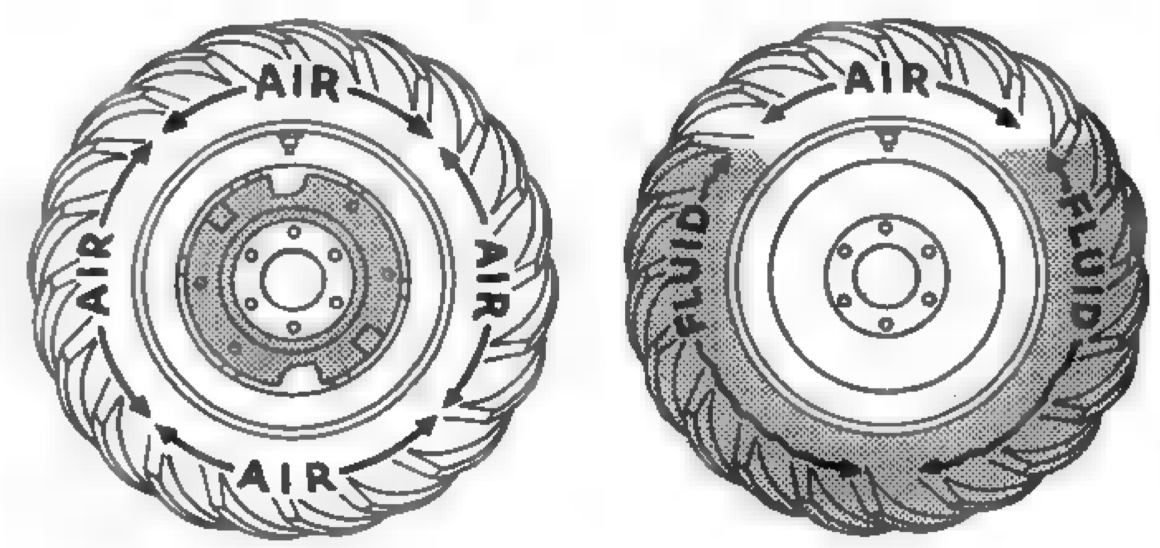


Figure 55—Proper inflation is of utmost importance in the life of rubber tires.

air pressure gauge and a good tire pump are essential in maintaining proper inflation. Proper inflation is especially important where fluid weight is used since the air space is greatly reduced (see Figs. 55 and 56). A special air-water gauge should be used for testing tires carrying fluid weight.

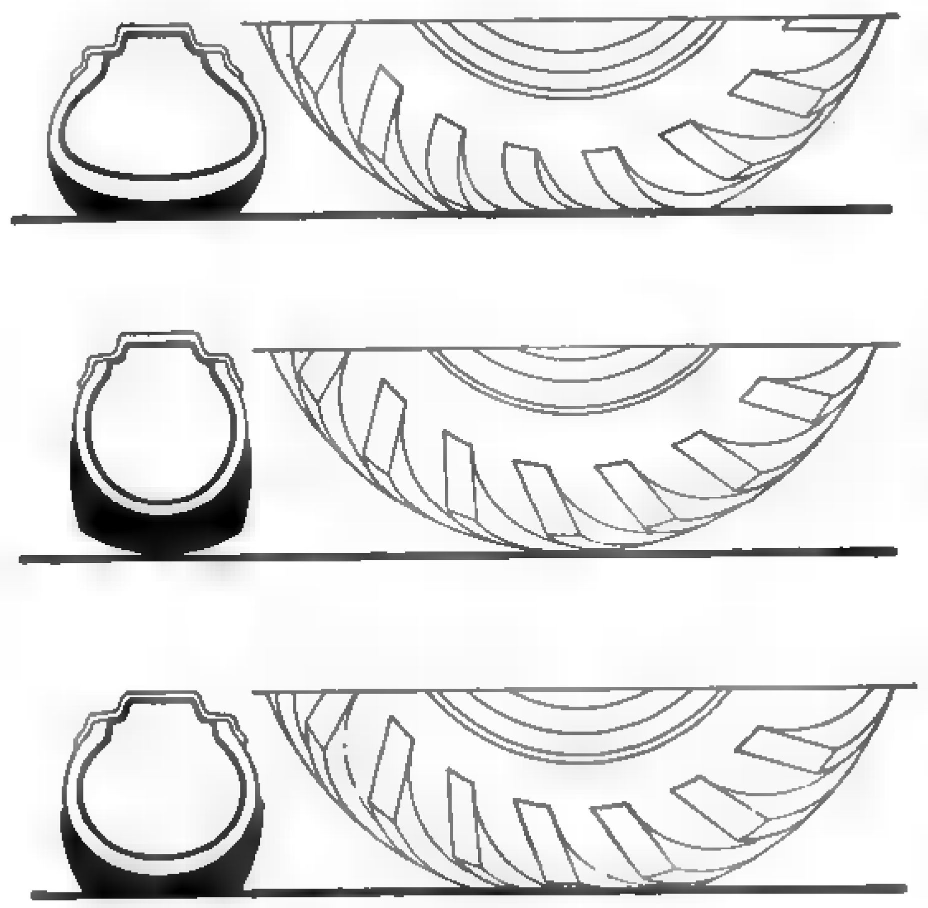


Figure 56—(A) Underinflated tire, (B) overinflated tire, and (C) properly inflated tire.

Grease and oil are natural enemies of rubber. Protect tires from oil and grease as much as possible. Should tires become spattered with oil or grease, wipe them off with a rag dampened with gasoline—but do this job *outside* the implement shed to reduce fire hazard. Never allow tires to stand in barnyard acids. If spray chemical gets on the tires, wash it off.

Inspect tires periodically for carcass breaks and cuts and have them repaired immediately. No cut is too small to require attention, for if it is not repaired, further damage will result.

Use tractor wheel weights (according to manufacturer's instructions) to secure maximum traction and minimum slippage.

Avoid high transporting speeds. Implement tires, unless otherwise specified, are not designed for speeds exceeding fifteen miles an hour. Take added precautions as tires age.

Don't overload. This applies particularly to combine grain tank extensions. Reduce speed and load, if possible, on rough ground.

Protect the tires of idle implements from sunlight.

When a rubber-tired implement is to be idle for a considerable time, block up the axles to take the weight off the tires, but leave the tires inflated.

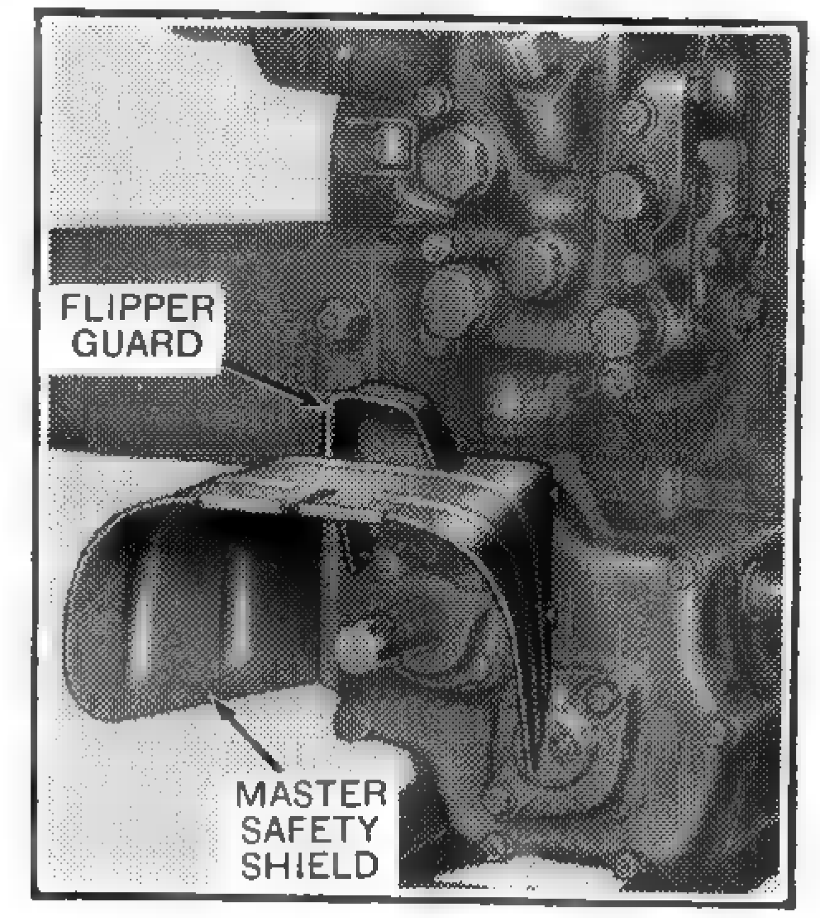


Figure 57—Shield should remain over the power shaft at all times.

Safety Precautions. Every year farmers are killed by accidents, many of which could have been avoided by using care in working with and around machinery. These are but a few of the many safety suggestions which should prove practical when working around the farm.

Only one person—the operator—should be permitted on the tractor platform when tractor is in operation.

Refuel your tractor only when the engine has been shut off. Do not smoke or use an oil lantern while refueling.

Be sure power take-off shields and guards are in place and in good order before starting field work.

Tractor brakes should be adjusted properly.

Do not oil, grease, or adjust a farm machine that is in motion.

Clothing worn by tractor or machine operator should be fairly tight and belted. Loose jackets, skirts, shirts, or sleeves should not be permitted because of the danger of getting into moving parts.

Never drive a tractor too close to the edge of a ditch or creek.

When your tractor is hitched to a heavy load, always hitch to drawbar and never take up the slack in chain with a jerk.

Always keep tractor in gear when going down steep grades.

Drive at speeds slow enough to insure your safety. Reduce to low speed before turning quickly or applying individual brakes. Drive slowly over rough ground.

Keep a firm grip on the steering wheel at all times when the speed is increased.

When hitching a drawn implement to the tractor, back the tractor past the clevis. Then move it slowly forward so that, in making the connection, the tractor will be moving away from you.

Provide a first-aid kit at the house for use in case of accident, and use the proper antiseptics on scratches, cuts, etc., without delay to prevent the possibility of blood poisoning.

Finally, remember this: An accident is usually caused by someone's carelessness, neglect, or oversight. The life you save may be your own.

Questions

1. *What is an internal-combustion engine?*
2. *What is the difference between a two-stroke cycle engine and a four-stroke cycle engine? What are the four strokes of the latter? What is the chief difference between the spark-ignition and Diesel engines?*
3. *What three elements are required for efficient engine operation?*
4. *What parts make up the fuel system; how would you check each part?*
5. *What is the importance of the air cleaner; how is it serviced?*
6. *Describe the function of the distributor. How would you check it for operating efficiency?*
7. *Describe a step by step check of the ignition system.*
8. *How does the oiling system of the tractor illustrated operate? Why is an oil filter of special importance in the modern tractor?*
9. *What is the function of the valves?*

10. *Why is the cooling system necessary? What attention does it require?*
11. *Describe the transmission of power from engine to drive wheels; belt pulley; power take-off; and power lift.*
12. *What is a differential unit? Describe a clutch.*
13. *What are the advantages of a power-shaft attachment?*
14. *How does the remote cylinder increase the usefulness of hydraulic power?*
15. *How should a battery be cared for?*
16. *Mention several of the important points in proper care of pneumatic tires.*
17. *Name five safety precautions everyone should know.*

PART TWO

PREPARATION OF THE SEEDBED

BEFORE discussing the implements used in preparing the soil for planting, it is well to consider, briefly, the results sought by their use. A clear understanding of the purpose and value of the machine studied is necessary before details of its operation and care can be fully appreciated. Thus, the reasons for certain adjustments on a plow become quite evident when we know that the basic purpose of plowing is to pulverize the soil and cover field trash.

The Ideal Seedbed. It is unwise to say that any one type of seedbed is desirable for all crops and all soils. The make-up and process of preparing what might be called a good seedbed in gumbo soil would differ greatly from that used in sandy soil.

In general, the seedbed should be roomy, thoroughly pulverized, and compact. It should have perfect contact with the subsoil to facilitate the rise of moisture. Large air spaces, bunches of field trash, and hard lumps or clods are undesirable, as their presence retards root growth and breaks the contact with the subsoil. The operations and the equipment employed in preparing a seedbed will vary with soil and field conditions and the results wanted.

Tillage Equipment. Implements used in preparing good seedbeds vary widely depending upon soil, territory, and crop to be planted. The moldboard plow is by far the most universally used, although the disk tiller, disk plow, field cultivator or tool-bar cultivator, and the disk harrow are important tools in seedbed preparation.

The Plow. The purpose of the plow is to pulverize or break up the soil, admitting air and light, and to cover surface trash or manure deeply and completely to be mixed with the soil to decay and release plant food to the subsequent crop. Under conditions where surface trash must be

covered completely to control such pests as the European corn borer, the moldboard plow, equipped with trash control aids, stands at the head of the list of seedbed-making tools.

The disk tiller, or one-way disk, was introduced originally in the Great Plains, where its big capacity speeded seedbed preparation and where its faculty for binding stubble to the surface soil made its use advisable as a soil and moisture conserving practice. The field of its effective usefulness has broadened to the extent that it is used to some degree in practically all parts of the country.

The disk plow which depends upon a rolling, cutting action to cut and turn soil is used primarily in sticky, waxy land where a moldboard plow encounters "shedding" or "scouring" difficulties, and in hard or dry ground or fields with such obstructions as rocks or stumps.

The Disk Harrow is a valuable implement when used before and after plowing, or when used alone in preparing seedbeds for some crops. It pulverizes clods, mixes trash with the soil, and forms a mulch when used before plowing. When used after plowing, it chops lumps, closes air spaces, and makes the seedbed compact.

Spike- and Spring-Tooth Harrows. Finishing the seedbed and destroying weeds before and after planting are the main purposes of spike- and spring-tooth harrows. Their crushing and stirring effect breaks up clods and crusted topsoil, leaving a fine surface mulch for planting or for plant growth.

Soil Pulverizer or Packer. The pulverizer, or packer as it is more commonly called, crushes lumps, closes air spaces, and leaves the seedbed firm, in ideal condition for planting. The packer is used extensively in territories where the soil tends to blow. It leaves an irregular, firm surface which does not blow so readily as a loose, regular surface.

Chapter II.

PLOWS

PLOW BOTTOMS

Importance of the Bottoms. A plow is no better than its bottoms. No matter how well the frame may be built, how modern its design, the plow will be only as satisfactory as its bottoms. If the bottoms fail to scour and turn the soil properly, the seedbed will be uneven and lumpy, resulting in lower yields. If the bottoms turn an even furrow, cover trash well, and pulverize the furrow slice as desired, a uniform seedbed will result.

Costly delays at plowing time are often caused by plow bottoms that refuse to scour. The trouble may be in the type of bottoms. It may be in the adjustment of the hitch, it may be due to dull or improperly-set shares, or to looseness or misalignment of the bottoms on the standards. The plowman must be constantly on the alert for signs of inefficiency in his plow bottoms.

Parts of the Bottom. The plow bottom consists of share, landside, moldboard, and frog (Fig. 58). The share and landside act as a wedge in the soil, cutting the furrow loose from the subsoil much as a wedge splits a log. The curved surface of the upper part of the share and the properly curved moldboard act as a single curve to invert the furrow slice.

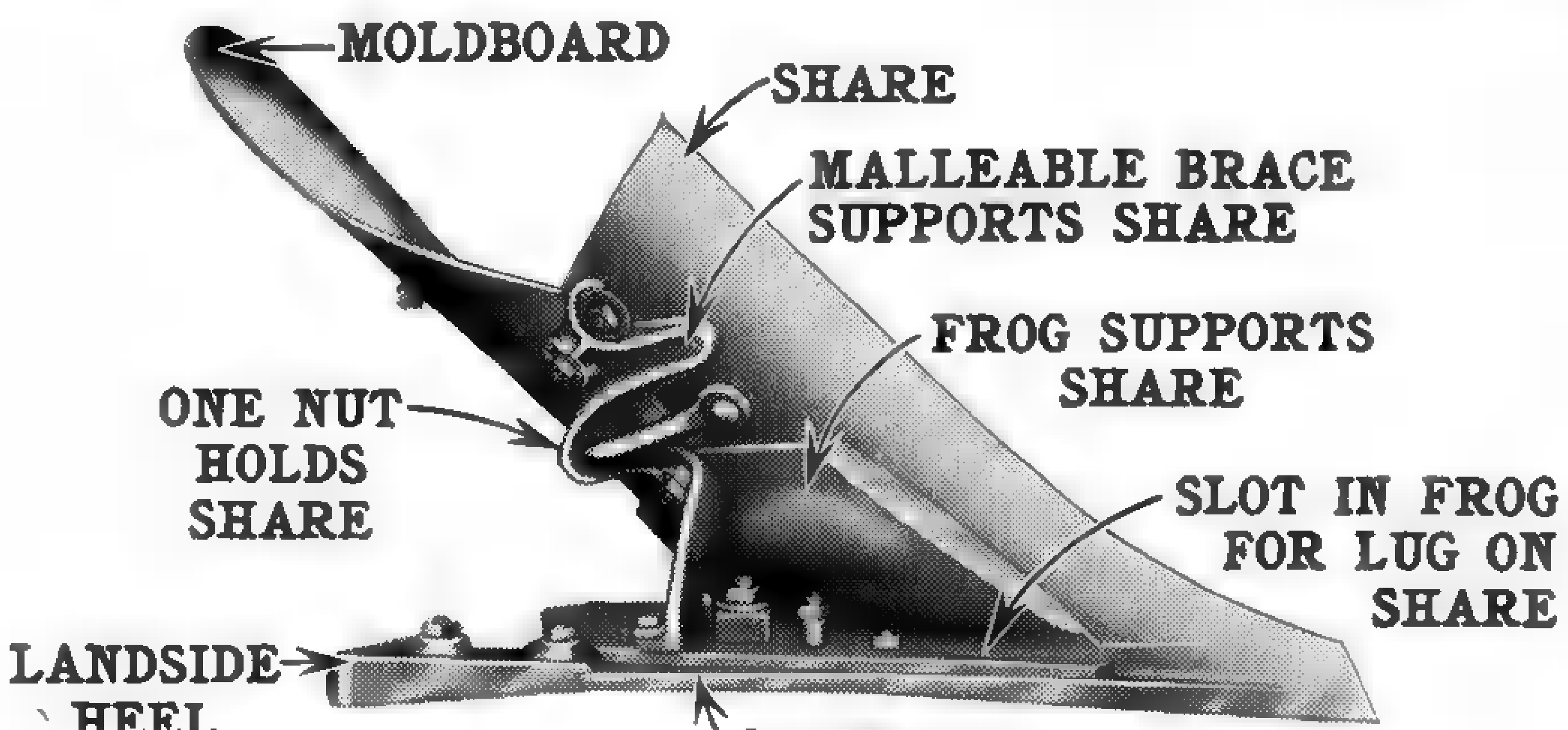


Figure 58—Plow Bottom with parts named.

In passing over this curved surface, the furrow is twisted and broken, and the soil is pulverized, mixed, and aerated.

The steel frog holds the bottom parts together. The landside and moldboard are bolted solidly to the frog, while the share, on most bottoms, is made quickly detachable to facilitate share changes. To remove or replace the share on the bottom shown in Fig. 58, it is necessary to loosen but one nut; this quick-detachable feature saves time when shares are removed for sharpening.

Certain types of chilled-iron plows have a detachable chilled shin-piece that serves as a long-wearing cutting edge for the shin of the moldboard where the hardest wear occurs (Fig. 59).

Types of Bottoms. Different types of soil require bottoms of different shapes to accomplish the results desired in plowing. The texture of the soil and the amount of moisture it contains, determine whether it should be pulverized thoroughly or merely turned over, to be pulverized with other implements. A mellow loam soil and soils of similar texture should be plowed with a bottom that will pulverize well, while a sticky, wet clay soil should be plowed with a bottom that will break it as little as possible, leaving the pulverizing to be done with other implements.

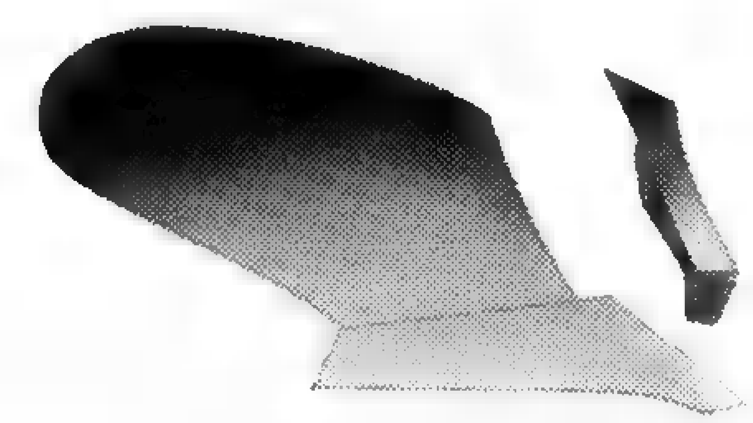


Figure 59—Chilled-iron bottom with detachable shin-piece.

The pulverizing effect of a plow depends upon the shape of its bottom. A bottom with a long, gradual curve in the moldboard turns the furrow slice gently and disturbs its composition but little. The other extreme is the short, abruptly curved moldboard that twists and shears the soil as it passes over it, making a mellow, well-pulverized furrow. The pulverizing effect produced by the curved surface of the moldboard is illustrated in Fig. 60.

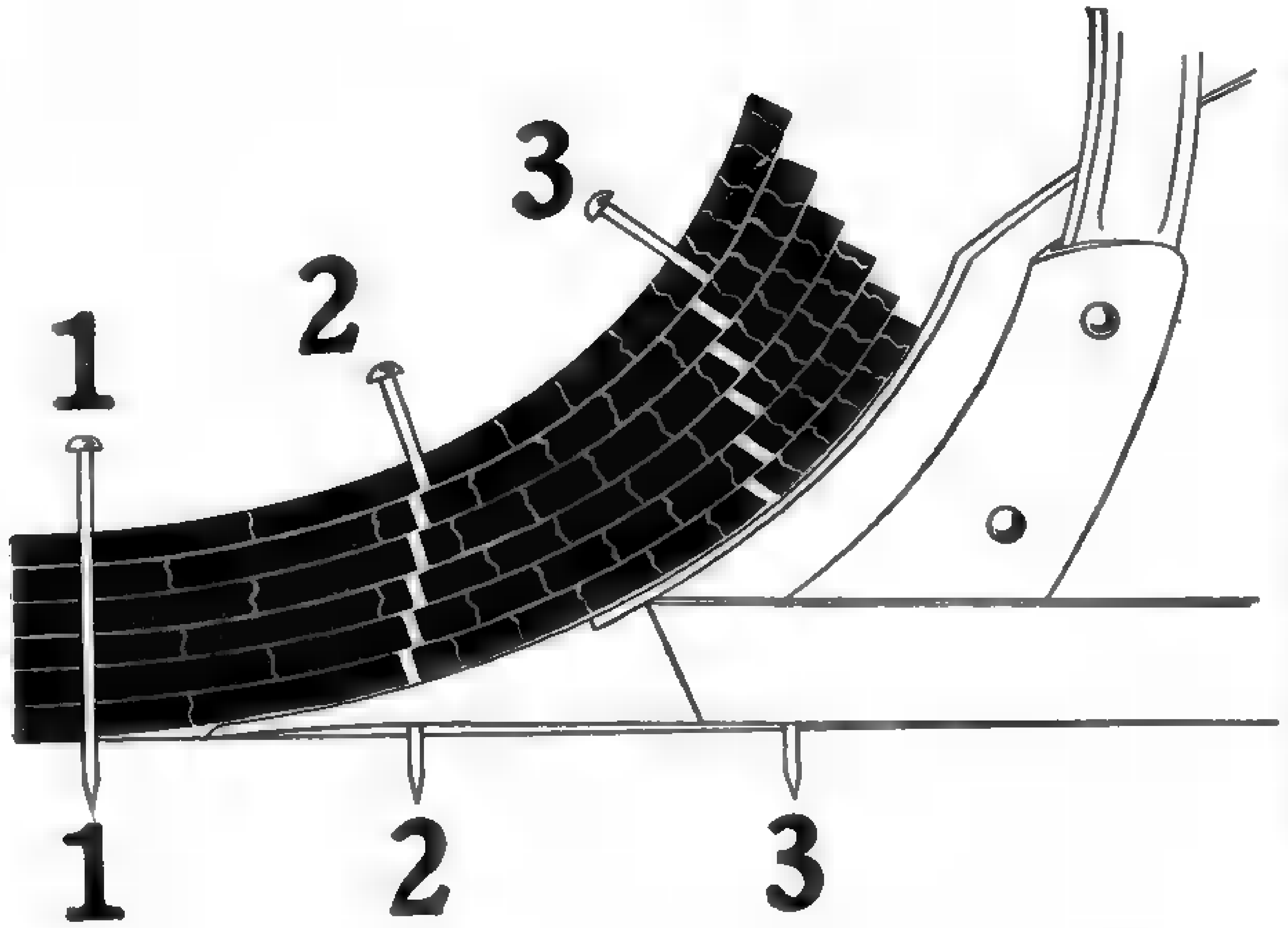


Figure 60—Principle of the pulverizing effect of the plow bottom under most soil conditions. The shearing effect produced by the curved surface is illustrated by pins 1, 2, and 3. Pin 1 is sheared into many parts when it reaches position of pin 3. Bending the pages at the corner of a book will illustrate this principle. The breaking effect produced by the curved surface is also illustrated.

Between these two extremes are many types of bottoms designed to meet many different soil conditions, but for general use, bottoms may be classified as breaker, stubble, general-purpose, slat moldboard, and blackland. The breaker (Fig. 61) is used in tough sod where complete turning of the furrow slice without materially disturbing its texture is desired. Stubble bottoms (Fig. 62) are especially adapted to plowing in old ground where good pulverizing of the soil is desired. General-purpose bottoms (Fig. 63) meet the demand for bottoms that will do good work in stubble, tame sod, old ground, and a variety of similar conditions. The general-purpose bottom is designed to do satisfactory work in the

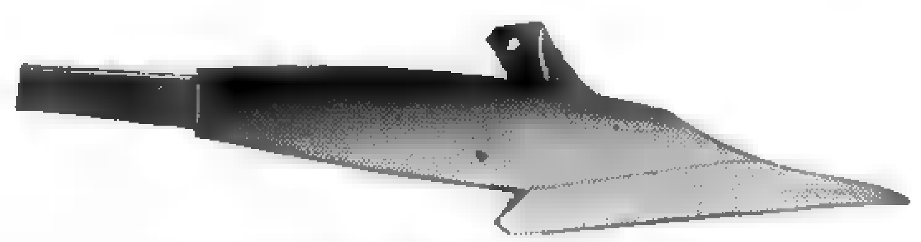


Figure 61—Breaker bottom.

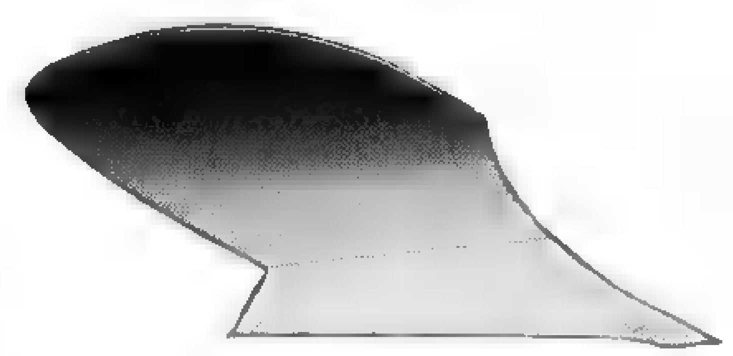


Figure 62—Stubble bottom.

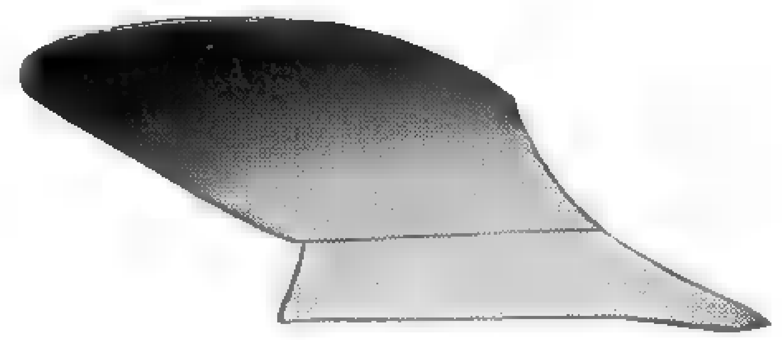


Figure 63—General-purpose bottom.

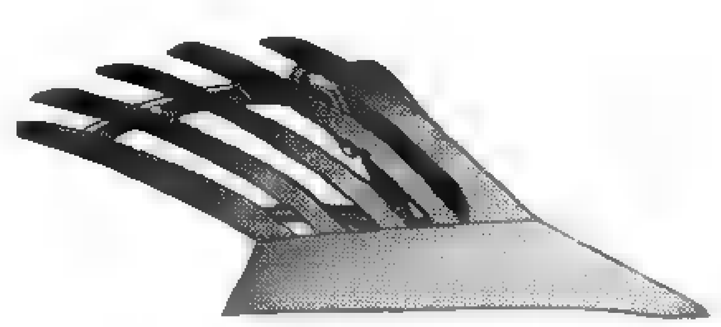


Figure 64—Slat moldboard bottom.

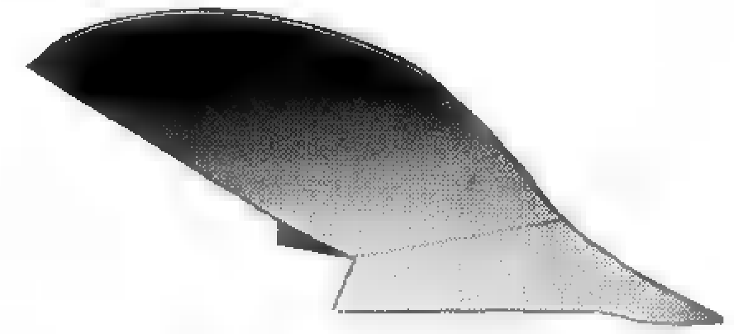


Figure 65—Blackland bottom.

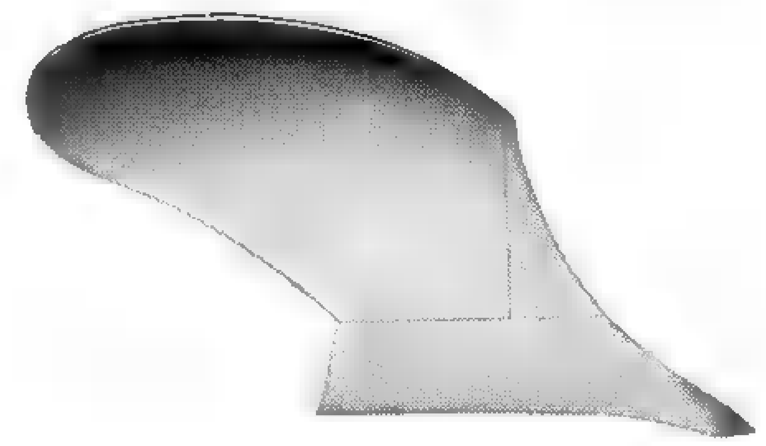


Figure 66—Deep-tillage bottom.

varying conditions found on the average farm.

The slat moldboard bottom (Fig. 64) is used in loose, sticky soils, and the blackland bottom (Fig. 65) in gumbo and "buckshot" soils. In both types of soil, scouring is a serious problem.

The deep-tillage bottom (Fig. 66) is used in certain restricted territories where it is desirable to plow to unusually great depths—as deep as sixteen inches.

There are a number of variations of these general bottom shapes built to meet a wide variety of soil conditions but, in every case, the manufacturer provides the implement dealer with the types of bottoms best suited to his territory.

Materials Used in Bottoms. Classified according to materials used in manufacture, there are two kinds of plow bottoms—steel and chilled cast-iron. Steel bottoms may be either solid steel or hardened soft-center steel. The latter bottoms are in more general use. In some sections, the soil conditions are such that a combination of chilled-iron shares and soft-center steel moldboards is used with excellent results. Both steel and chilled bottoms are used by some farmers who have varying soil conditions on their farms.

Soft-Center Steel Bottoms. A very highly polished, fine-textured steel moldboard is necessary for good scouring in sticky, fine-grained soils. Soft-center steel has the necessary hardness and thickness for good scouring and long wear on the outer surfaces, and

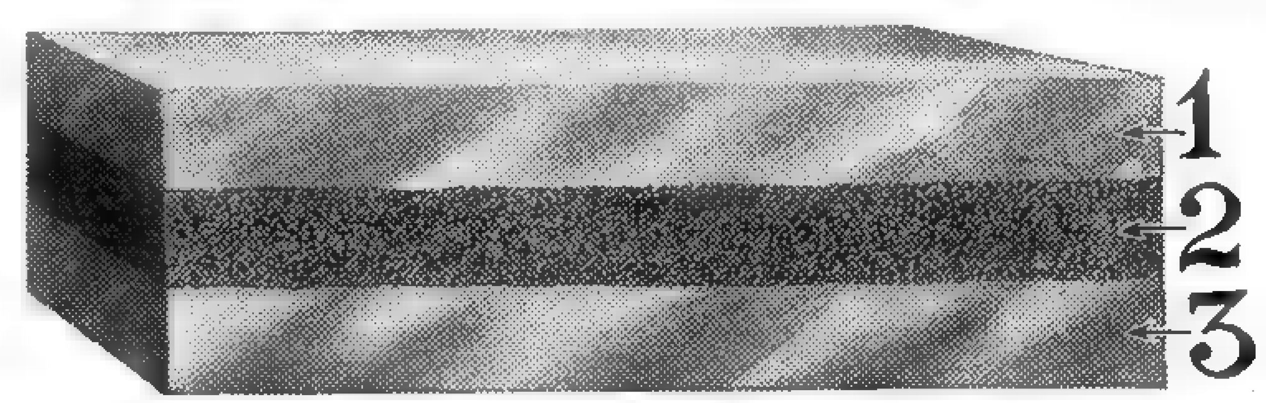


Figure 67—Genuine soft-center steel. Nos. 1 and 3 are layers of high-carbon steel, harder than that commonly known as "tool steel." No. 2 is a layer of soft, tough steel, the hard steel having been fused to it. Note uniform thickness of layers.

strength enough in the inner layer to withstand shocks and heavy loads in difficult soils. The outside layers are very high in carbon, extremely hard, dense steel. Between these two hard layers is a layer of soft, tough steel, the hard steel having been fused to it (Fig. 67). In genuine soft-center steel, all three layers are uniformly thick. There is no outcropping of soft spots, no thin places in the outer layers to wear through rapidly. Fig. 68 shows cross-section of a genuine soft-center steel share point, illustrating how the top and bottom of the point are armored for longer wear by wear-resisting plates of tool steel.

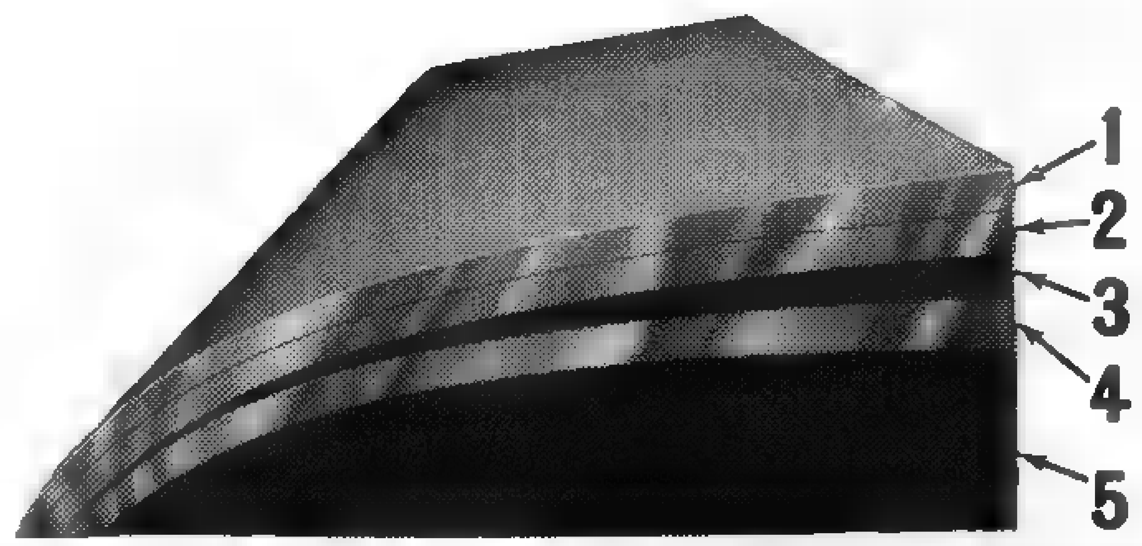


Figure 68—Genuine soft-center steel share point. 1, 2, and 4—Hard steel. 3 and 5—Soft steel. Note thickness of hard-steel layers.

Solid Steel Bottoms. Bottoms made of solid steel, untempered, are used in soils where scouring as a rule is not difficult. They should not be used in sandy or gravelly soil, as they wear too rapidly under these conditions. Solid steel shares are sometimes used with soft-center steel moldboards where soil conditions do not require the more costly soft-center steel shares for scouring.

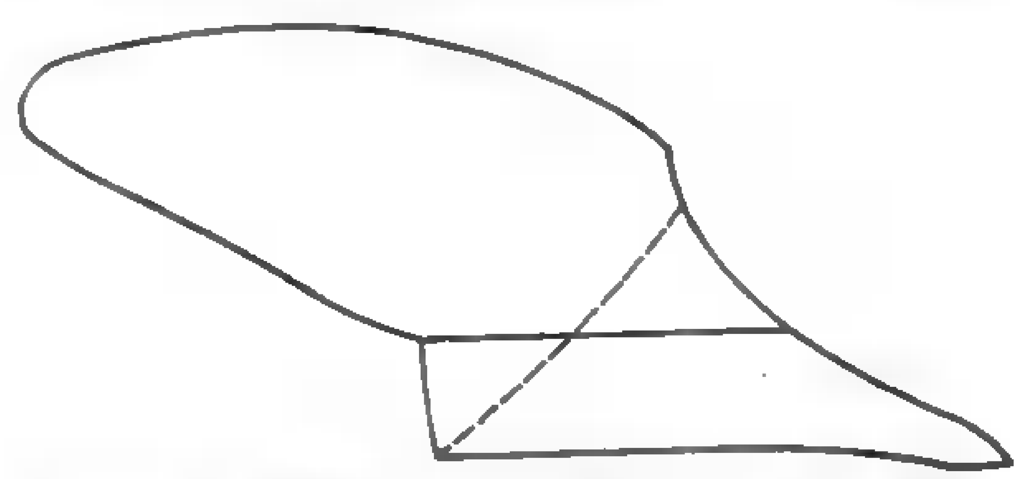


Figure 69—Plow bottom showing area, below dotted line, which receives 75 per cent of the draft when plowing, illustrating the necessity of keeping shares sharp for light draft of the plow.

Chilled-Iron Bottoms. Plow bottoms made of chilled iron are designed primarily for use in sandy or gravelly soil where the share and moldboard must


Figure 70—Heavy lines show proper shape of sharp share points for good penetration. Dotted lines show how worn points look before sharpening.

withstand the scratching and hard wear of soil of this type, and where the denser, finer-grained surface of more costly soft-center steel is not necessary for scouring. The material used in these bottoms is extremely hard and long wearing due to a process called "chilling."

In casting chilled shares, a piece of metal called a "chiller" is placed into the mold along the cutting edge and point where the finished share is to be chilled. When the hot metal comes into contact with the "chiller," the sudden cooling leaves the grain of the metal at right angles to the surface. Thus, the dirt rubs the ends of the grain in the metal when passing over the share. A smooth and long-wearing surface results. Chilled shares may be sharpened by grinding but, because of their low cost, it is usually more satisfactory to replace worn shares with new ones.

Sharpening Plowshares. The share is the most vital part of the bottom. It is the "business end"—the pioneer part in all the work that a plow does. Draft, penetration, steady running, and good work all depend upon the share. Note Fig. 69 which shows the area of the plow bottom that is responsible for 75 per cent of the draft when the plow is at work. This illustration shows clearly the importance of keeping the share in good cutting condition at all times. Note, also, Fig. 70. A dull share may cause poor penetration and may greatly increase the draft of a plow. A sharp, correctly-set share adds to the efficiency and good work of the plow bottom.

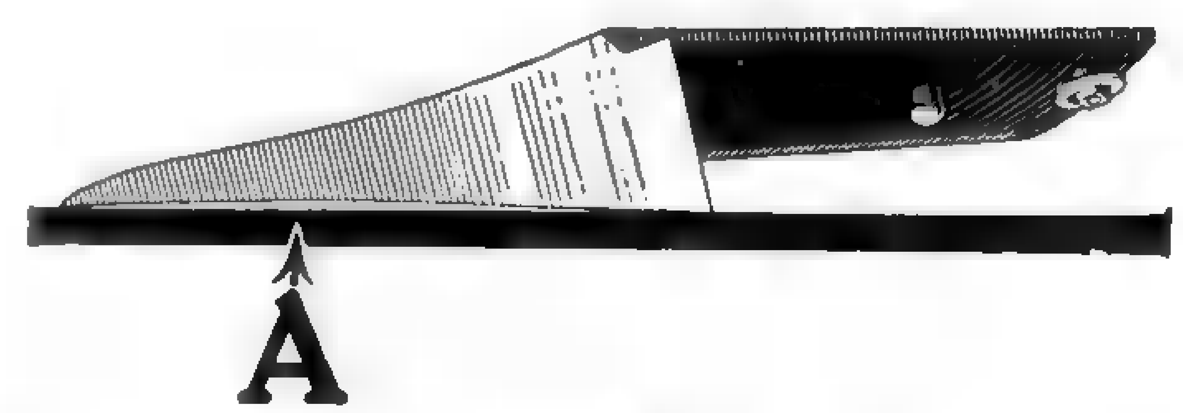


Figure 71—Illustrating underpoint suction in landside of a plowshare.

Figure 72—Illustrating underpoint suction in throat of a plowshare.

Many farmers have shop equipment for sharpening their plowshares, while the great majority depend upon local blacksmiths or mechanics for this service. In either case, it is well to know how shares should be sharpened.

When sharpening soft-center or solid-steel shares, the point of the share should be heated to a low, cherry red (not too hot) and hammered on the top side until the point is sharp. Hammering should be done at a cherry red only, since working the share at a high heat destroys the quality of the steel. The entire cutting edge should be drawn from the underside until sharp. Only as much as can be hammered should be heated at one time. The body of the share should not be heated while sharpening, but should remain cool to prevent warping and disturbing of the fitted edges.

Should the share get out of shape or the fitted edges become warped during the sharpening process, the entire blade should be restored to proper shape before hardening. This can be done best at a black heat.

Soft-center steel shares should be hardened after sharpen-

Figure 73—Bottoms are the "business end" of the plow, for no plow is better than its bottoms.

ing. To do a thorough job of hardening, it is necessary to prepare the fire to heat the entire share uniformly to a cherry red. Care should be used in getting the heat uniform. The share should be taken from the fire and dipped into a tub of clean, cold water with the cutting edge down. Care should be taken to keep the blade in a perpendicular position during this process.

Solid steel shares should not be hardened.

Setting Shares for Suction. The plow bottom is led into the ground and held to its work by the underpoint suction of the share. Such suction is produced by turning the point of the share down slightly below the level of the underside of the share (see Fig. 71). The amount of suction

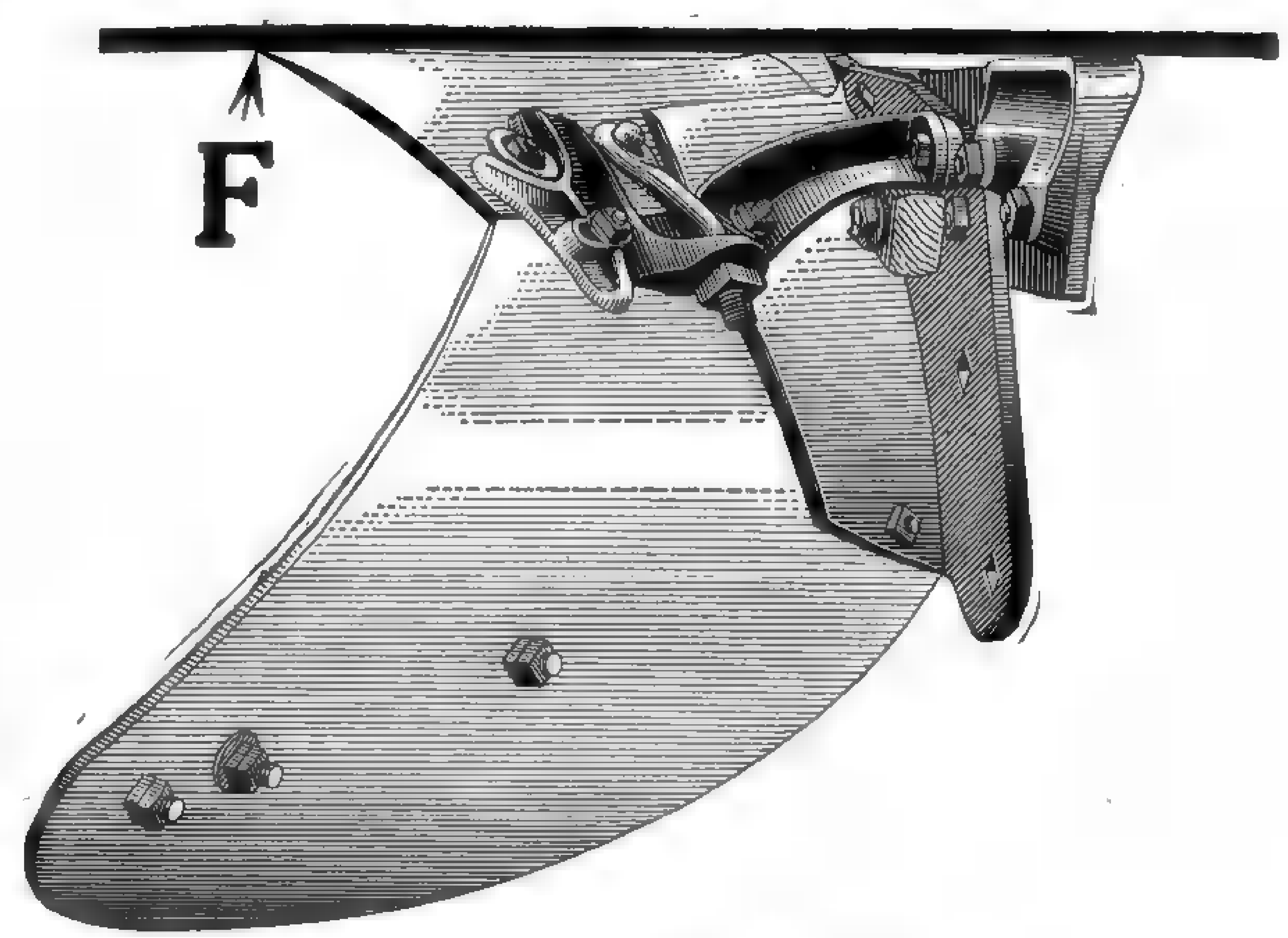


Figure 74—Tractor plows do not require wing bearing at "F."

necessary depends upon the type of plow and existing soil conditions. Plows to be used in stiff clay soils, which are harder to penetrate than light loam soils, require more suction in the share point.

Landside suction (see Fig. 75) in a plowshare holds the bottom to its full-width cut and is produced by turning the

point of the share toward the unplowed ground. The land suction, as well as the down suction, should be measured when the share is new, so that the same amount of suck can be given the share when it is sharpened.

The importance of having the correct amount of suck in the share cannot be emphasized too strongly. Too little underpoint suction will cause the plow to "ride out" of the ground and cut a furrow of uneven depth. Too much will cause "bobbing" and heavy draft. In either case, the plow will not operate smoothly. If the landside suction is too great, the bottom tends to cut a wider furrow than can be handled properly, and the reverse is true when the landside suction is not sufficient.

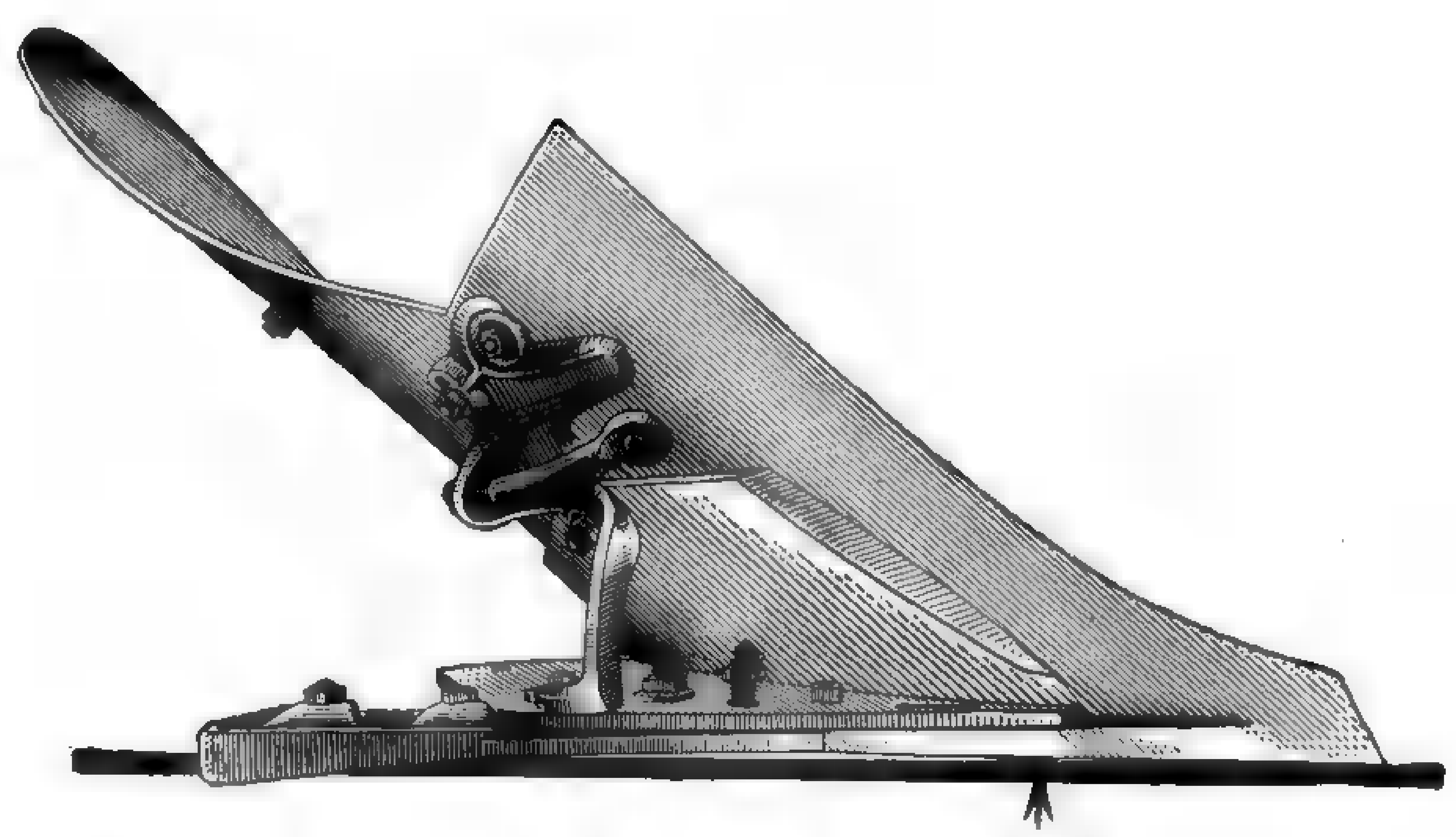


Figure 75—Landside suction should be set at approximately 3/16-inch clearance at "H."

To secure proper suction, set the point of the share down until there is 1/8- to 3/16-inch suction under the landside at point "A" (Fig. 71). See that clearance in throat of share at "B" (Fig. 72) is at least 1/8-inch. Set edge of share at wing point "F," without wing bearing (Fig. 74). For landside, set should be about 3/16-inch clearance at "H" (Fig. 75).

Care of the Bottom. The plow bottom will give the best satisfaction when given the best care. If kept in good condi-

tion, it will give little scouring trouble. If permitted to rust, it may cause any amount of hard work and lost time.

One of the first rules a plowman should learn is to keep the bright surfaces of his plow bottoms well polished and to apply a light coating of oil whenever the plow is not in use. Strict observance of this rule will save many hours of difficulty in getting a rusted surface repolished. A heavy coating of a good, hard oil or good rust preventive should be applied to the bottoms when storing the plow from season to season.

Plow manufacturers paint or varnish the surfaces of new plow bottoms to protect them from moisture from factory to user. This protective coating must be removed before the plow is taken into the field. This can be accomplished best by means of a paint and varnish remover which is obtainable at most paint stores. A can of concentrated lye dissolved in two or three quarts of water will serve the same purpose. The solution should be applied with a swab or a piece of gunny sack, the operator being careful not to get it on his hands. After the coating has been softened in this manner, it can be scraped off readily with a putty knife or similar instrument, care being taken not to scratch the polished surface.

If the new plow is not to be used immediately after this protective covering has been removed, the bottoms should be oiled, as the metal rusts readily if exposed to the air after treatment with the suggested strong solutions.

In case a plow bottom becomes badly rusted, working it in a coarse sandy or gravelly soil will aid in restoring a land polish or if too badly pitted, it may be necessary to have it reground at the factory.

Rolling Coulter and Jointer. One of the most important duties of the plow is to cover the stubble, stalks, or other trash usually found on the surface of a field. Thorough covering of such matter hurries its decomposition and makes

cultivation of future crops less difficult than when trash is left on top of the seedbed to clog cultivating machines. Complete covering of surface trash is an absolute necessity where plowing is intended to control the spread of such pests as the European corn borer.

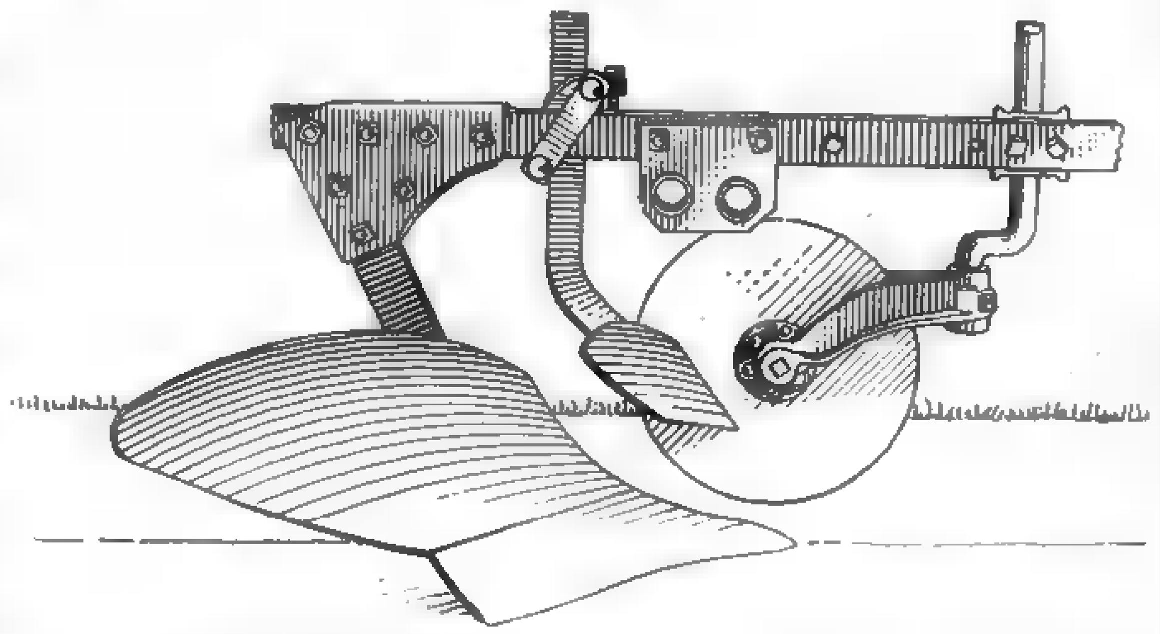


Figure 76—Rolling coulter and independent jointer properly adjusted for good work.

The rolling coulter and jointer attachments for moldboard plows have proved to be big aids to clean plowing and good covering. Their value has grown in importance with the advent of high-powered, high-speed tractors. At higher plowing speeds, the work of the rolling coulter and independent jointer (Fig. 76) is indispensable in maintaining perfect plowing performance. The rolling coulter cuts through the surface trash and aids in securing a clean furrow wall, reducing the draft on the cutting edge of the plow bottom. In reality, the jointer is a miniature plow, the purpose of which is to cut a small furrow off the main furrow slice and throw it toward the furrow in such a manner that all stubble and trash are buried in the bottom of the furrow.

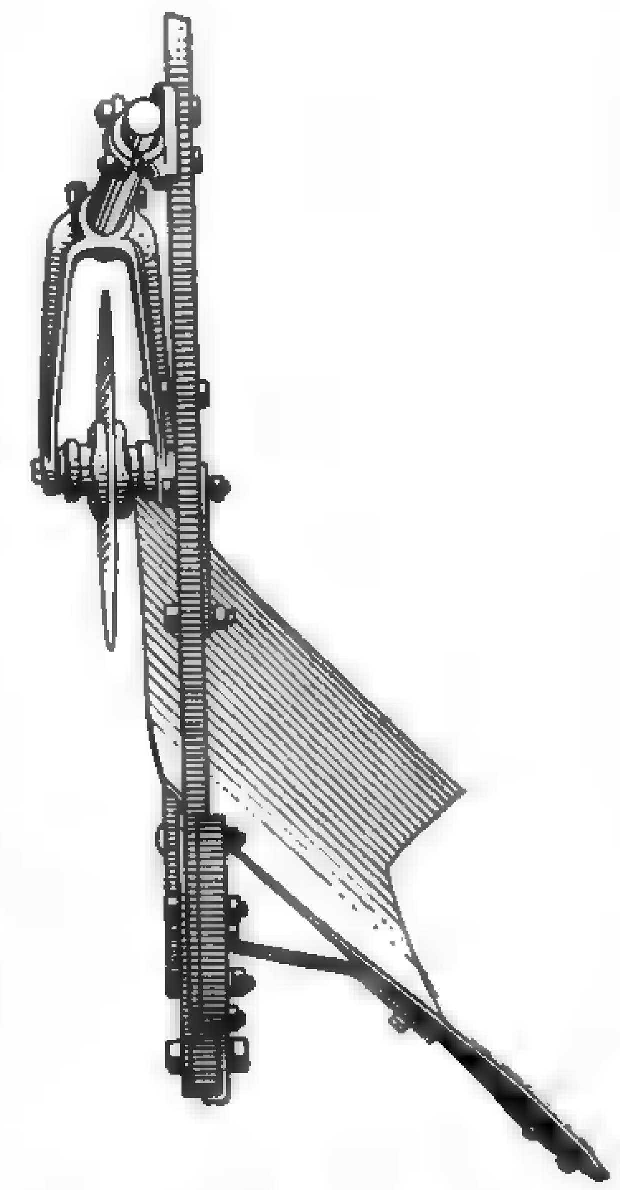


Figure 77—When used alone, the coulter should be set 1/2- to 5/8-inch to the land, and the hub should be about 3 inches to rear of the share point.

For best results, the hub of the coulter should be set about one inch back of the share point with the blade running just deep enough to cut the trash, about three to four inches in ordinary conditions. The jointer should cut about two inches

deep. There should be about 1/8-inch space between the jointer and the coulter blade.

When the rolling coulter is used alone, it should be set about 1/2- to 5/8-inch to the land (Fig. 77). The hub of the coulter should be about three inches behind the point of the share. In soil that does not scour well, more pressure on the

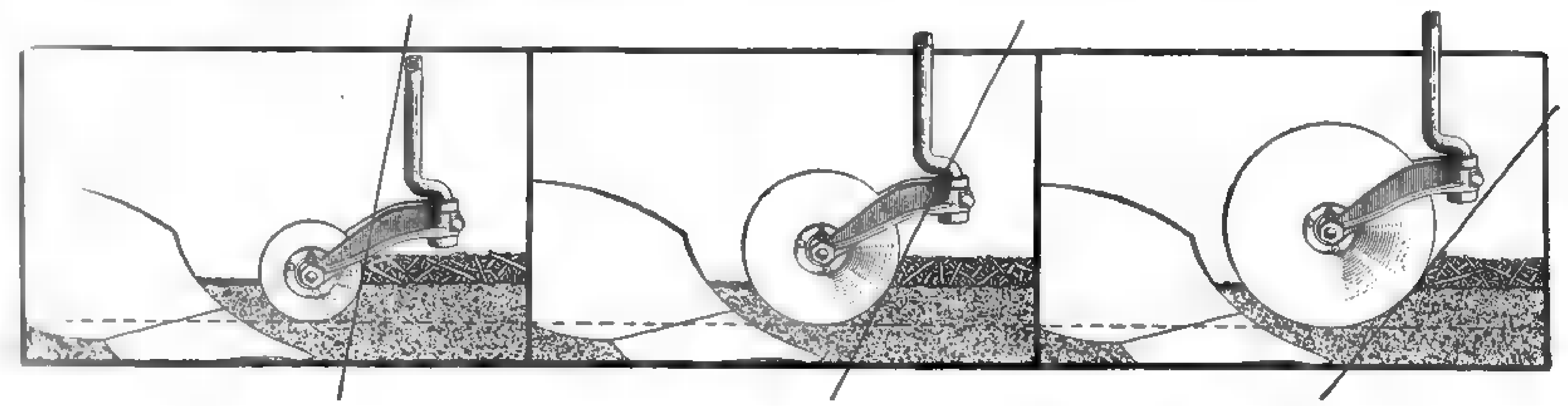


Figure 78—Large rolling coulters mount trash more readily than small ones, thereby insuring a clean-cut furrow with less draft.

moldboard can be secured by setting the coulter farther to land. If there is considerable trash on the field, the coulter should be set just deep enough to cut it—if set too deep, it pushes instead of cuts trash. The larger rolling coulters prove more effective in trashy conditions, as they mount trash more effectively than smaller coulters (see Fig. 78). When plowing sod, the coulter must be deep enough to cut the roots below the surface, usually about one inch shallower than the share is cutting.

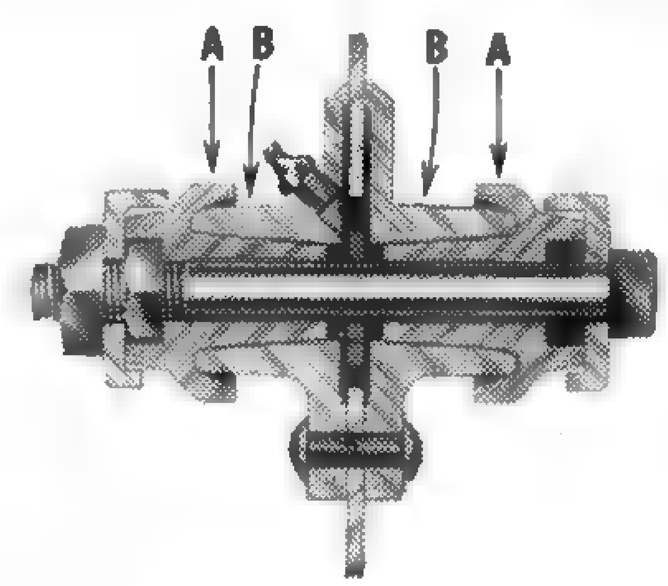


Figure 79—Cross-sectional view of adjustable rolling coulter bearing with adjustable sleeves indicated at "A" and "B."

Many present-day coulters are equipped with adjustable bearings which provide means for taking up wear which may occur. Figure 79 shows a cross-sectional view of this type of coulter bearing. When a small amount of wear develops, adjusting the inner nut will keep the coulter blade running true.

Keeping the rolling coulter sharp and well oiled and the jointer sharp and properly set will add greatly to the efficiency of their work.

Questions

1. *Why is a good bottom essential to good plowing?*
2. *Name the parts of a plow bottom and tell the purpose of each.*
3. *How is the plowshare removed for sharpening?*
4. *Describe the relation between shape of moldboard and its pulverizing effect upon the soil.*
5. *Name the five general types of bottoms and tell purposes of each.*
6. *In what kinds of soil are chilled cast-iron bottoms used?*
7. *What is the difference between solid steel bottoms and soft-center steel bottoms? Tell purpose of each.*
8. *Why is it important to keep plowshares sharp? Describe process of sharpening soft-center and solid steel shares.*
9. *What is meant by "underpoint suction" and "landside suction" in a plowshare, and what is the purpose of each? Describe results of improper suction and tell how to measure correct set for plowshares.*
10. *How would you care for plow bottoms when in use and when not in use? How would you remove factory varnish from plow bottoms?*
11. *Describe purpose and proper adjustment of the rolling coulter and jointer. Mention the advantages of their use.*

TRACTOR PLOWS

The modern tractor plow is one of the most important items of farming equipment. When we consider the work it does—cutting, lifting, turning, and pulverizing tons of soil, burying surface trash deeply and completely—it becomes apparent that time is well spent in acquainting ourselves with its operation, care, and adjustment.

In the previous pages, we discussed the plow bottom and its importance as the basic part of the plow; here we shall discuss the different types of plows and the adjustments necessary for best operations under varying conditions.

Tractor moldboard plows are built in several types or styles to meet the requirements of farmers in all sections of the country. Tractor-drawn plows are available with from one to five bottoms to match the power available on farms of various sizes and to meet plowing conditions. Integral or tractor-carried plows are built for most general-purpose tractors, while two-way plows, used widely in irrigated

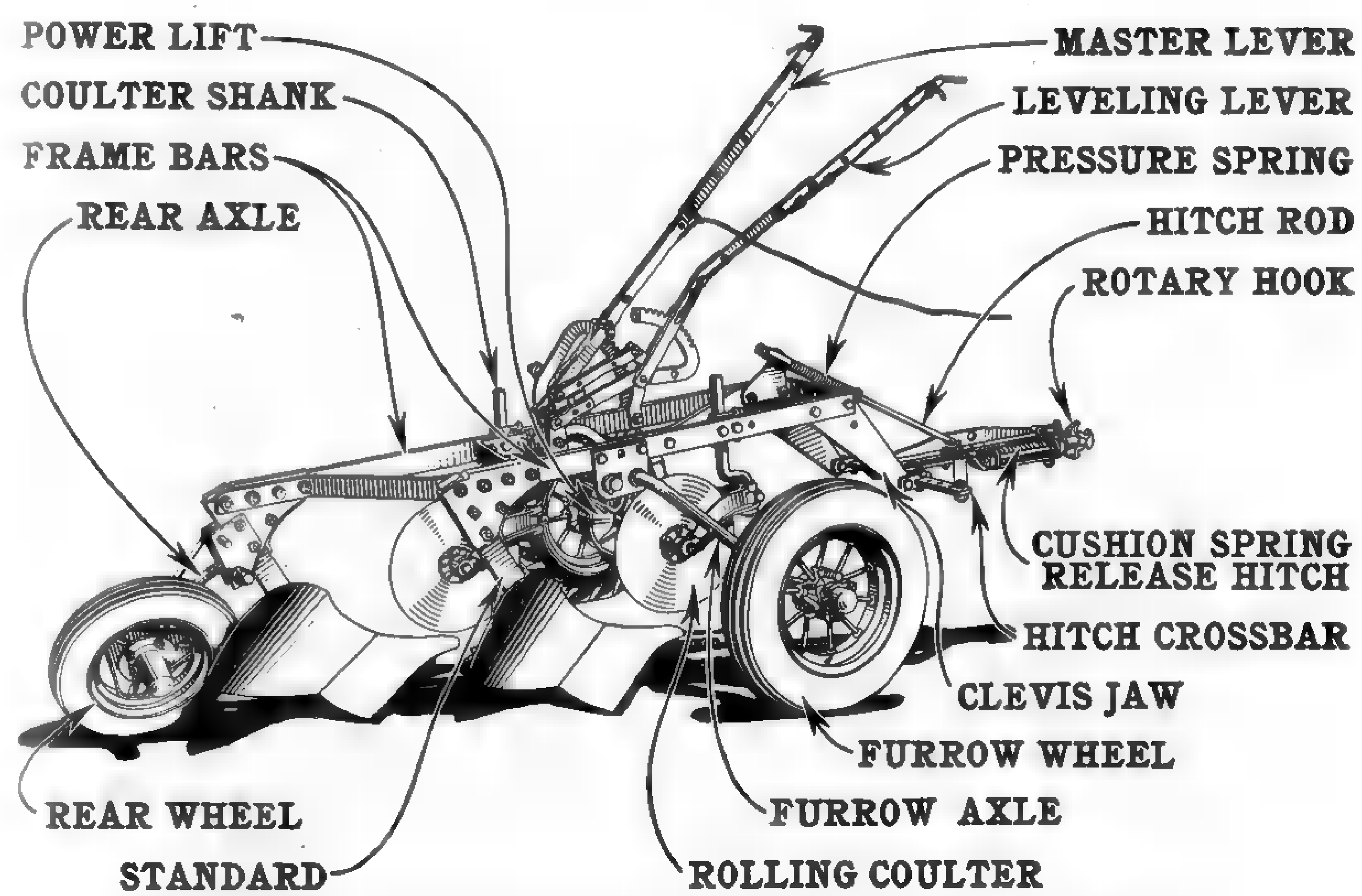


Figure 80—Two-bottom tractor plow with important parts indicated.

regions, hilly farms and, frequently, in plowing on the contour, are available in drawn and integral types. The market gardener, the farmer who has small, irregular fields to plow, and many others who find it an advantage to turn all furrows one way, find the two-way especially valuable.

The two-bottom tractor-drawn plow (Fig. 80) is probably the most generally used size and type because of the popularity of the general-purpose tractor of "two-plow" power. Fig. 81 illustrates a larger plow of similar construction, matched to the need of the farmer of larger acreage. Plows of extra-heavy-duty construction, designed for deep plowing in the heaviest types of soil, are usually equipped with deep tillage bottoms (Fig. 66) to meet the specific needs for which their greater strength is required.

Fig. 83 illustrates an integral or tool carrier-type plow. Attached to the general-purpose tractor, the carrier-plow becomes a compact unit with the tractor; the power lift of the tractor, raises and lowers the bottoms. Depth is varied and the plow leveled by means of adjustment levers on the tool carrier.

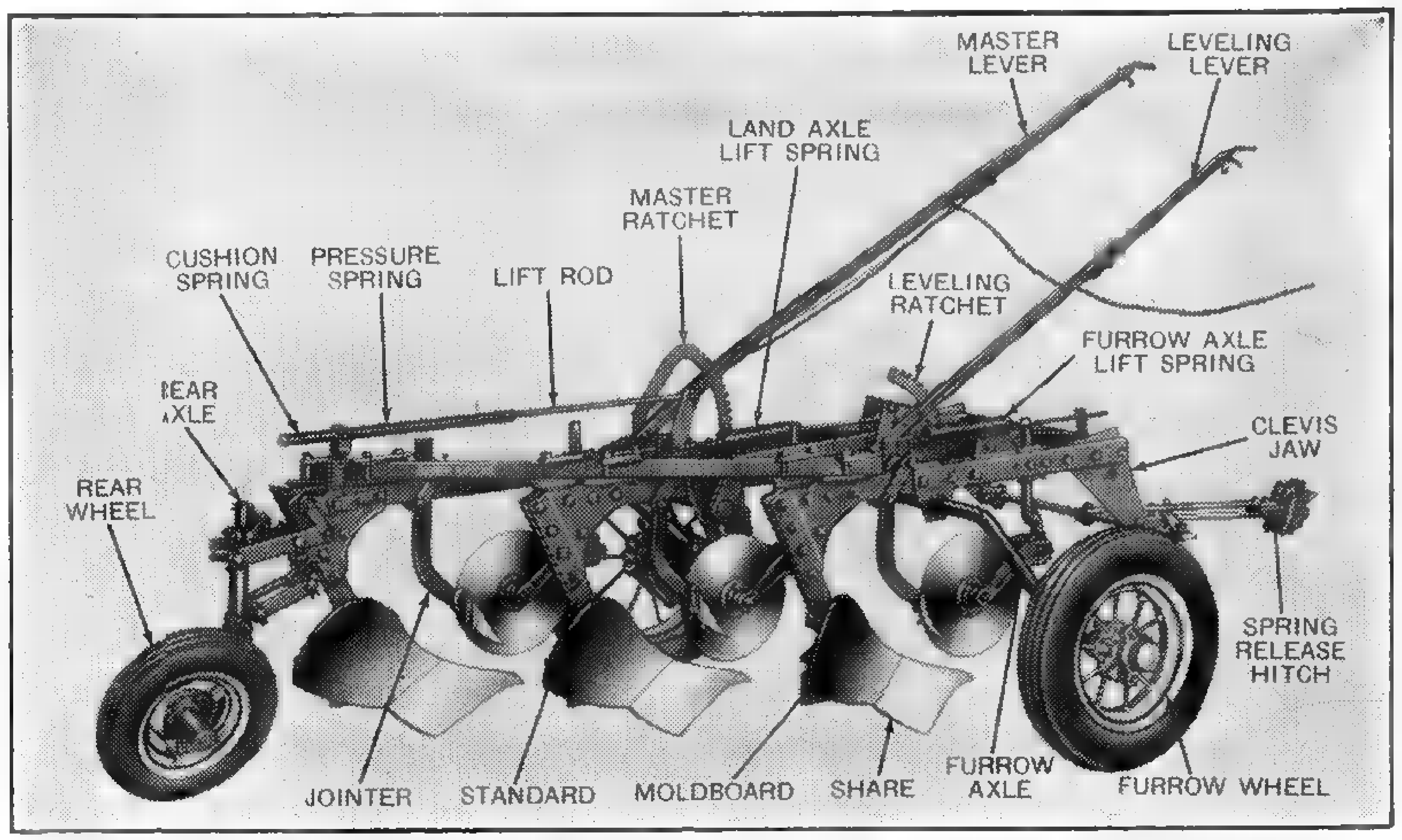


Figure 81—Three-bottom truss-frame plow with principal parts indicated.

A tractor-drawn two-way plow is shown in Fig. 82. Power-lift units (right- and left-hand) raise and lower the bottoms, while lever controls provide for depth and leveling adjustments. The two-furrow, two-way plow is shown in Fig. 84.

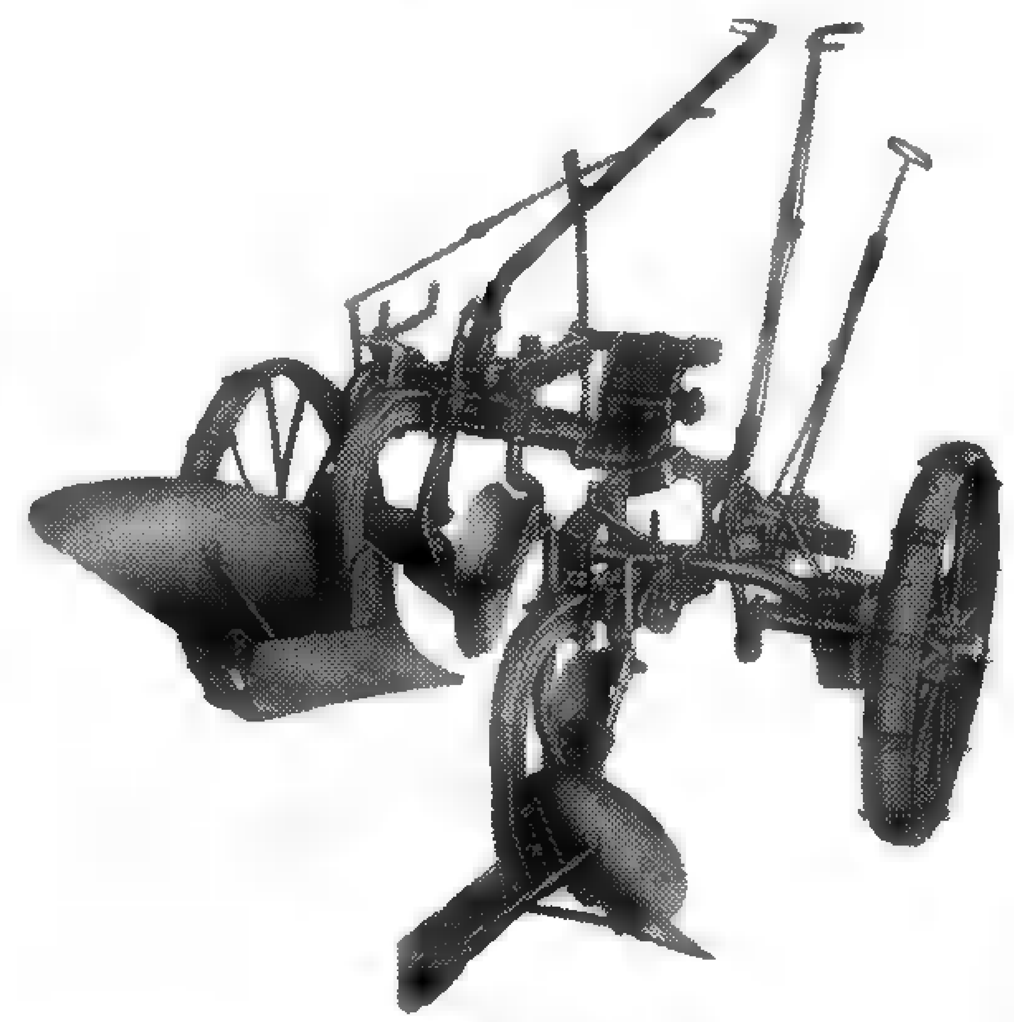


Figure 82—Tractor-drawn two-way plow.

Operation of Plows. The first important consideration in gaining good plowing performance is the condition of the plow bottoms. Bottoms must be in proper adjustment; shares and rolling coulters must be sharp; wheels must be properly set; and the plow must be hitched correctly if good work is to be expected.

Figure 83—The integral three-bottom tool carrier plow, with general-purpose tractor.

When a new plow is delivered by the implement dealer, it is usually in proper adjustment for efficient work. If the rear wheel adjustment becomes loose and permits the landside to become lower than the rear furrow wheel, the rear furrow wheel axle should be moved up until there is 1/2-inch space beneath heel of the landside on the rear bottom. On plows having rolling landside in place of rear wheel, no adjustment is necessary.

The depth or master lever on a tractor plow is used only for setting the depth. After the proper adjustment for depth is made, the plow is leveled, by adjusting the leveling lever, to insure a uniform, smooth job of plowing at the depth set.

The power lift, built into the land wheel, is simple and positive. The operator simply pulls the trip rope and the bottoms are lifted high and clear for turning or transporting. When the turn is completed, the bottoms are lowered by pulling the rope in the same fashion. The power lift shown in Fig. 86 is designed for especially long life. Greased and

Figure 84—The two-furrow, two-way plow at work.

sealed at the factory, it requires no periodic change of lubricant and no adjustment.

The lifting spring should have proper tension. If the spring has too much tension, it will cause the land wheel to slide when plow enters the ground. If not tight enough, the land wheel may slide a little when plow is being lifted. Adjust by loosening or tightening.

When plows are equipped for remote control through a hydraulic cylinder actuated by the tractor power lift (Fig. 85), all operating field adjustments are made by the operator from the tractor seat. The power lift of the tractor, operating through the remote cylinder attached to the plow, raises and lowers the bottoms and varies the depth as required in field operation. When depth of plowing is to be changed greatly, the plow must be leveled by means of leveling lever or crank on the plow.

Figure 85—A two-bottom plow equipped with hydraulic control.

The hitch for tractor plows should be one of three types—spring release, cushion-spring-release, or cushion hitch with automatic tractor clutch release. When a field obstruction is met with the cushion-spring-release type, the load is carried on heavy coil springs which are compressed when the load becomes too great, thereby permitting the hitch to release the plow.

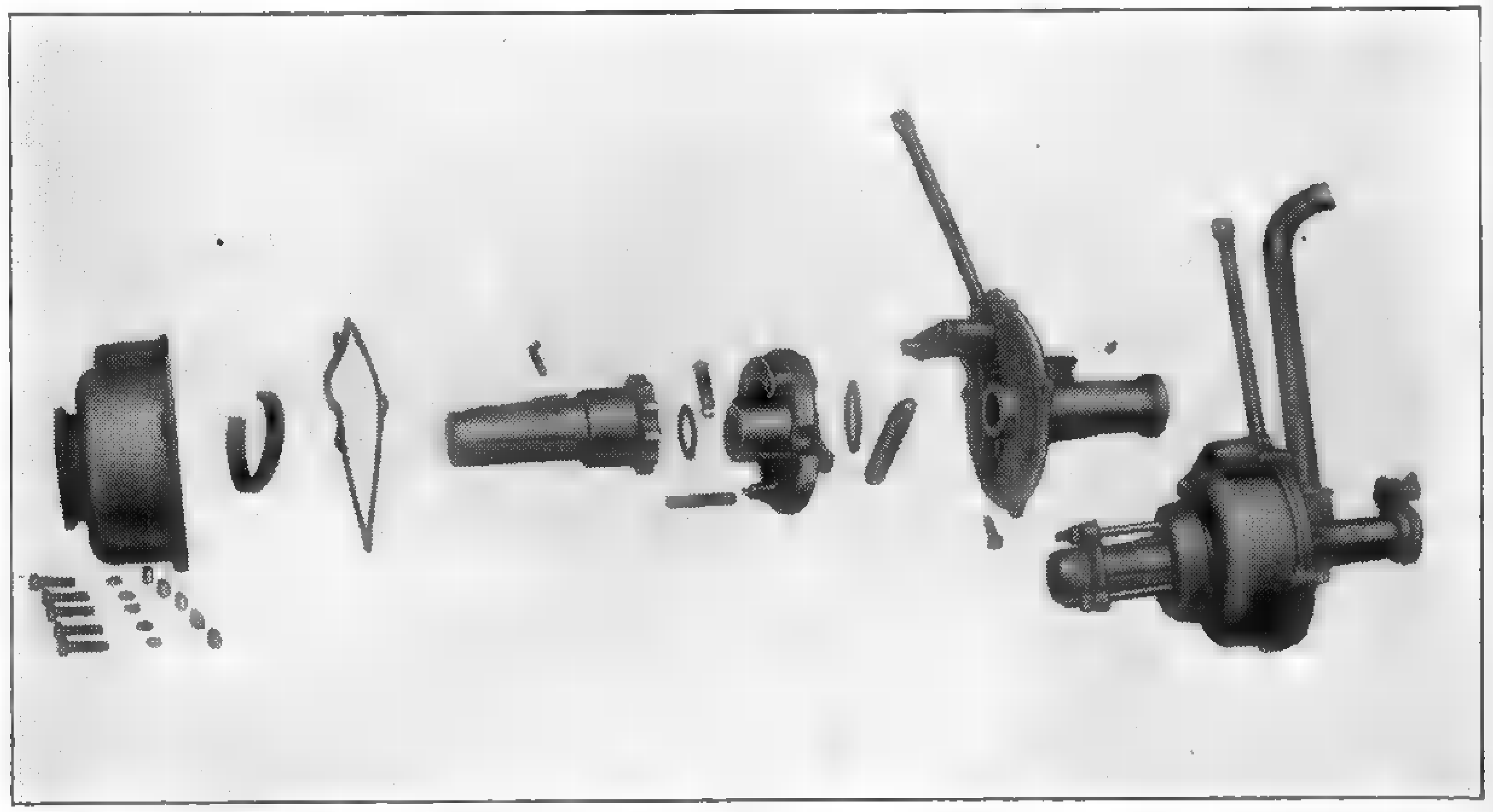


Figure 86—The enclosed power lift is shown completely assembled, right, and "exploded" to show component parts. The entire lift is sealed to exclude dirt and to retain oil. Principal parts shown are: cover, felt strip; gasket; box; lifting clutch; and axle journal assembly.

A modern example of the cushion-spring-release or safety hitch is shown in Fig. 87. Clevis ring is latched to the revolving hook which revolves on the long U-bolt which carries the two compression springs. Under normal field conditions, the load is cushioned by the springs, since the pull is applied to the springs through the U-bolt. As the strain becomes too great, or when a field obstruction is encountered, the springs are compressed, permitting the revolving hook to make a half-turn, releasing the plow. As the load is released, the revolving hook snaps back to position ready for rehitching. Rehitching is accomplished simply by raising the hitch and

backing the tractor into position and dropping the hitch latch into the clevis ring.

Release-type hitches should be adjusted to tripping pressure which will release the plow if a large rock or other dangerous obstruction is encountered, but will not trip from normal soil resistance. With automatic tractor clutch release hitches, the chain connection to the tractor clutch control should be adjusted to disengage the clutch when excessive load is imposed on the cushion springs.

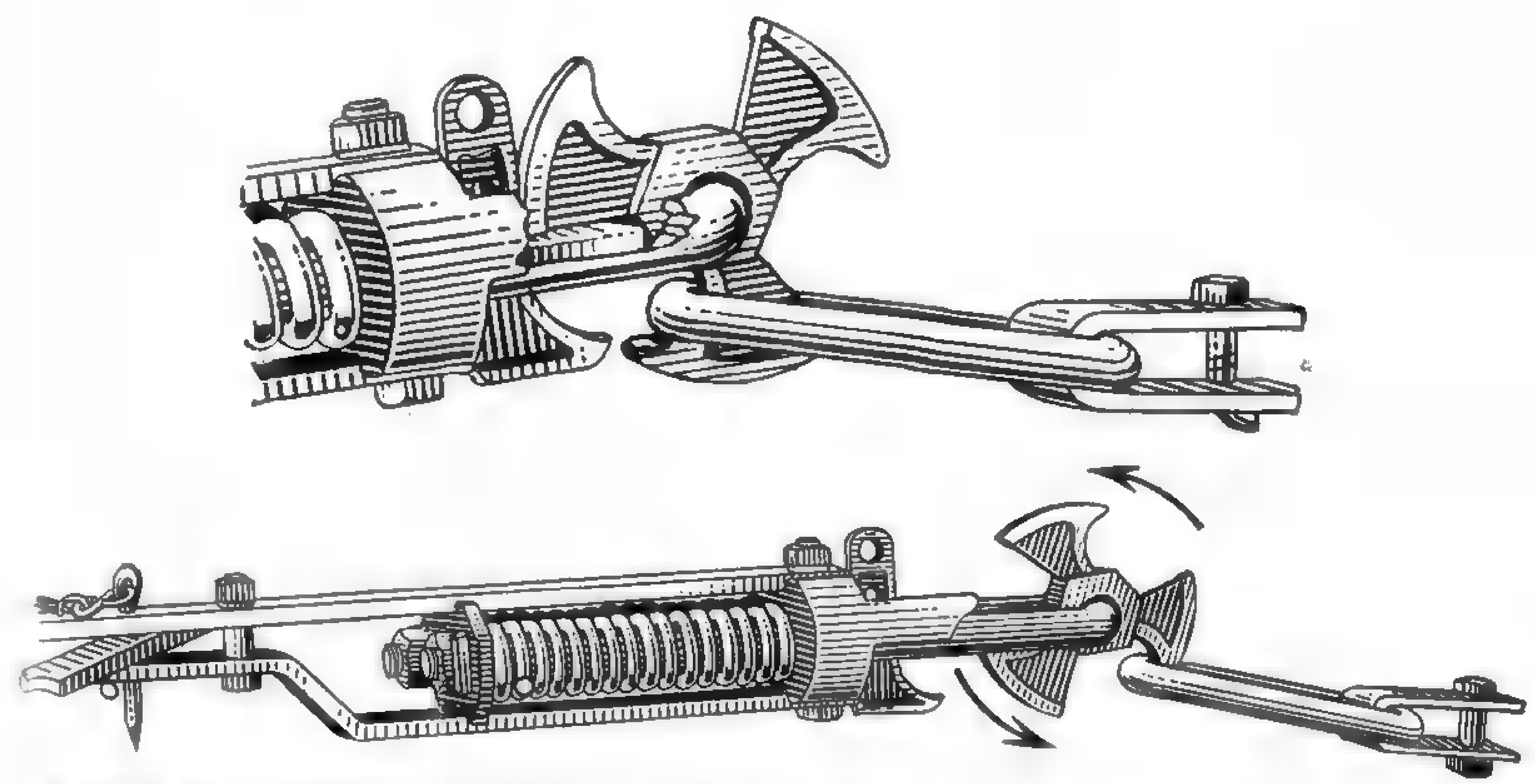


Figure 87—Cushion-spring-release hitch. Cutaway view above shows revolving hook in pulling position. Lower illustration shows springs compressed under load, permitting hook to revolve, releasing the plow.

Care of Tractor Plows. It is a good plan to go over the plow before storing and to put it in condition for the next season's work. Sharpen shares or get new ones if the old ones are too badly worn; tighten bolts, replacing where needed; readjust or replace any parts that show excessive wear. Reconditioning plows during slack seasons saves time in the busy plowing season.

While the plow requires but little servicing in the field, what servicing is required is highly important. Thorough lubrication at correct intervals, a frequent check of coulter and jointer adjustment, and inspection of shares and sharp-

ening when necessary, will do much to insure fine field performance from your plow.

Hitching Tractor Plows. The most important factor in tractor plow operation is correct hitching. Draft, quality of work, and ease of operation depend, to a great extent, on whether or not the hitch is made properly. Improper hitching can result in higher fuel consumption, harder steering, and poor all-around performance.

The ideal hitch is a straight line from the point of resistance on a plow to the point of pull on the tractor, both horizontally and vertically. Before hitching the plow, be sure that the tractor tires are inflated properly, as directed by the operator's manual, that the swinging drawbar is locked in the proper position, and that the tractor rear wheels are set properly. Generally the center line of draft of the plow is located at a point one quarter the cutting width of one bottom, measured to the left of the center of the total cut of the plow.

For example, in the illustration below (Fig. 88) three 14-inch bottoms are used. The total cut is 42 inches. One half the total cut is 21 inches. This is the center of cut. One quarter the width of one bottom is 3-1/2 inches. Measuring 3-1/2 inches to the left of center of cut brings the center line of draft to 24-1/2 inches from the furrow wall.

Rear wheels of the tractor should be set so that the distance from the center of the tractor to the inner side of

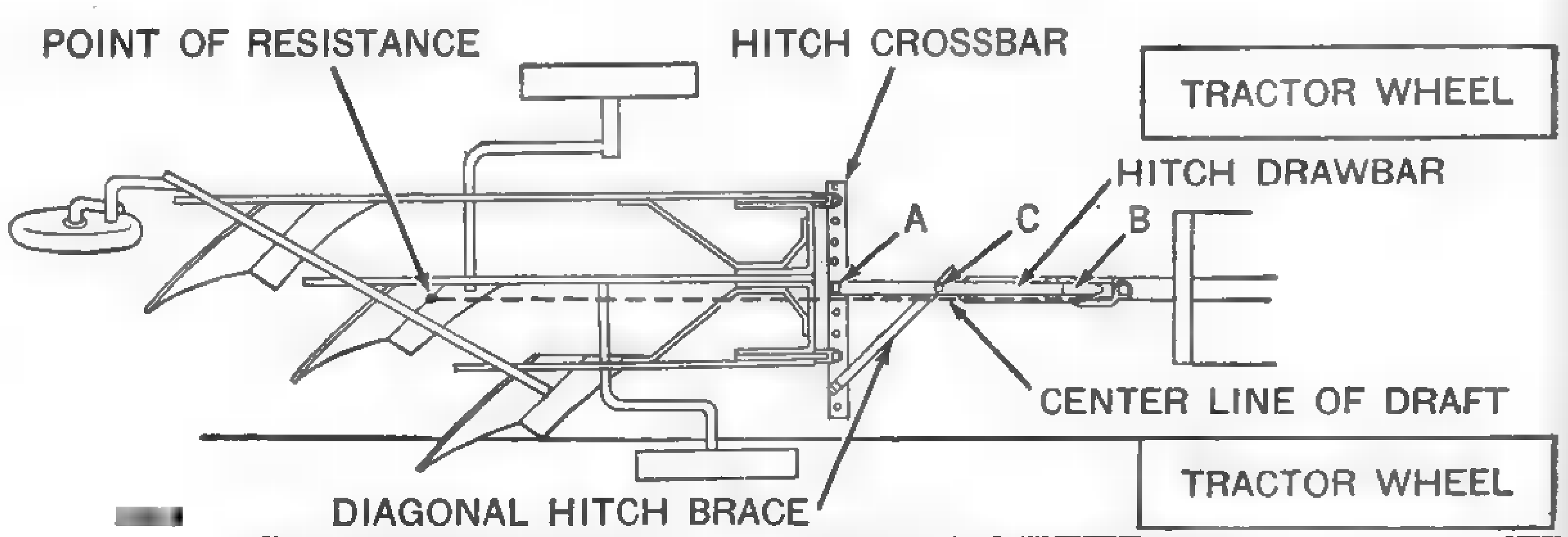


Fig. 88—Horizontal adjustment for plowing.

the tire is the same as the distance from the furrow wall to the center line of draft of the plow. In this particular case it would be 24-1/2 inches. Both wheels should be set the same distance from the center of the tractor.

Where a smaller plow is used and it is impossible to get the tractor drawbar exactly on the center line of draft, the tractor wheels should be set to the narrowest tread and the plow "off-hitched" by shifting the plow hitch at point "C." The line of draft should always be parallel to the furrow wall.

The point of resistance on the plow bottom is located at a point approximately one half of the plowing depth. When plowing 6 inches deep, for example, the point of resistance will be 3 inches up from the furrow bottom. Figure 89 shows the correct hitch of tractor plows. The hitch is in line with the line of draft as shown by line "B," the hitch point, and "D," the point of resistance. The correct hitch at "E" is the place where "E" is in a true line between point of hitch, "B," and the point of resistance, "D," on the plow.

If the clevis jaws are adjusted too high, the resulting down pull on the front of the plow tends to raise the rear gangs. Likewise, if the clevis jaws are adjusted too low, you will pull up the front end of the plow.

Careful adjustment of the hitch assures an even running plow and a good job of plowing.

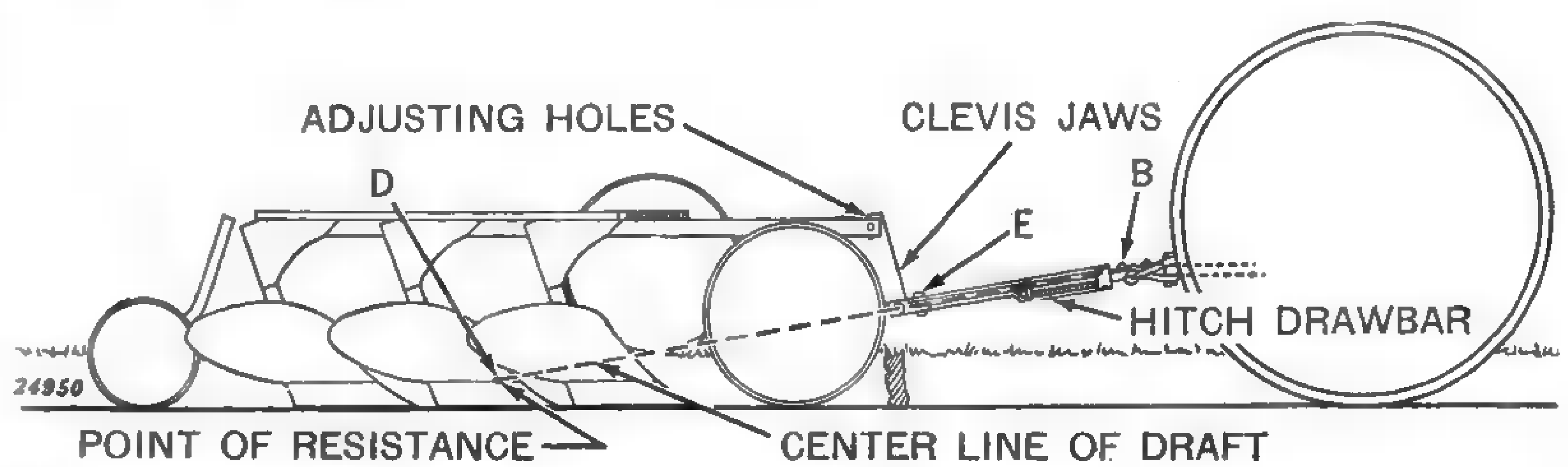


Figure 89—Vertical drawbar adjustment for plowing.

How to Plow a Field. Where fields are plowed in "lands," a definite plan is necessary to good plowing and time-saving with a tractor plow. The plan of opening and plowing in lands, as shown in Fig. 90, has been found very practical. It reduces to a minimum the amount of time spent in turning and moving with the bottoms out of the ground. Details of this plan are given with the illustration.

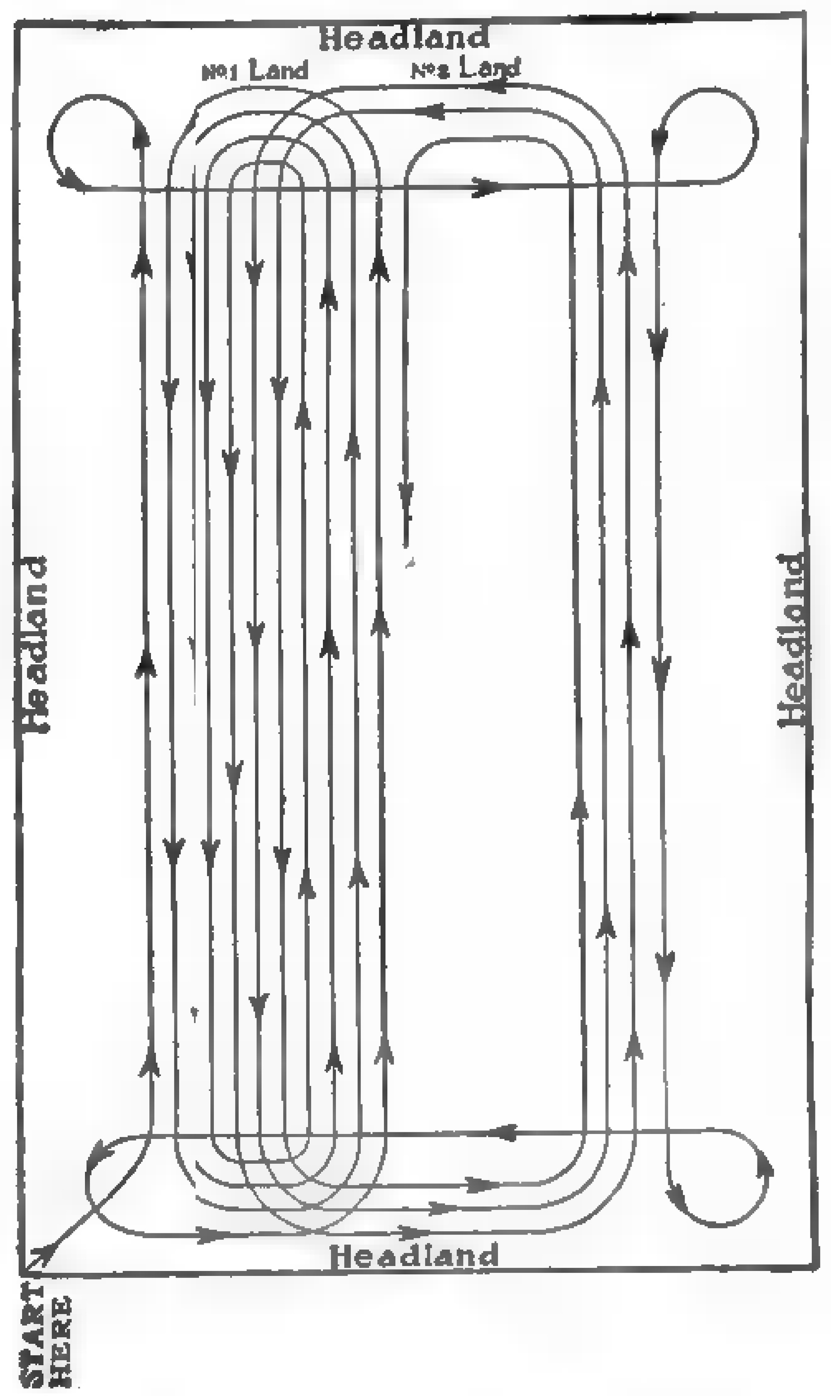


Figure 90—Plan for laying out and plowing a field with a tractor and plow:

First—Stake out headland, about twice the length of the outfit, clear around the field. This gives all room necessary for turning at ends.

Second—Plow a furrow clear around the field, as staked out. These furrows may be thrown in or out. However, it is recommended to throw in, as this leaves the headland in better shape to finish. Then, too, the head furrows mark the point to raise and lower the plow. To begin the furrow, drop the plow when the first bottom reaches the dead furrow. This leaves square headlands.

Third—Open land as shown in diagram; arrows show direction of travel. After land No. 1 has become too narrow to permit the sweeping turn, swing over and open up land No. 2, plowing alternate furrows in both lands until land No. 1 is finished. Then plow land No. 2 until it is too narrow for turning; open the third land and so on.

Fourth—After all lands are plowed, start in at one corner and plow around until the entire headland is plowed and field finished.

On contoured land, plowing should be done as near as possible to parallel the contour lines. The actual operation will vary so widely from field to field that it is impossible to give instructions to meet all conditions in a book of this type.

Questions

1. *Describe several types of tractor plows and tell the conditions to which they are adapted. What type is most generally used in your community?*
2. *How would you adjust the rear wheel of a tractor plow for best work?*
3. *What is the purpose of the leveling lever?*
4. *What is the purpose of a cushion-spring-release hitch?*
5. *How would you obtain the correct vertical hitch on a tractor plow? The correct horizontal hitch?*
6. *How would you open a field for plowing with a tractor?*

DISK PLOWS

Types and Uses. Disk plows are used in territories where soil conditions are such that moldboard plows will not operate to best advantage. They work well in soil so dry and hard that moldboard plows cannot penetrate, and in sticky soils, such as waxy muck, gumbo, and hardpan, where moldboard plows will not scour well. They are also used to advantage in very loose ground and in stony, stumpy, and rooty land.

The disk plow illustrated in Fig. 91 is a popular size for use with the medium-sized farm tractor. In addition to this size, there are lighter and heavier plows of similar design, and semi-integral or tractor-carried types (Fig. 93) built for use with the modern general-purpose-type tractor. For use with larger, heavier, more powerful tractors, there are several types of heavy-duty and extra-heavy-duty plows (Fig. 94) designed to meet the toughest plowing jobs encountered.

Operation and Adjustment. Since all disk plows operate on practically the same principles, the plow shown in Fig. 91 will serve as a basis for this discussion.

Disks must operate at the same level to do an even job of plowing. The rear wheel may be raised or lowered by the

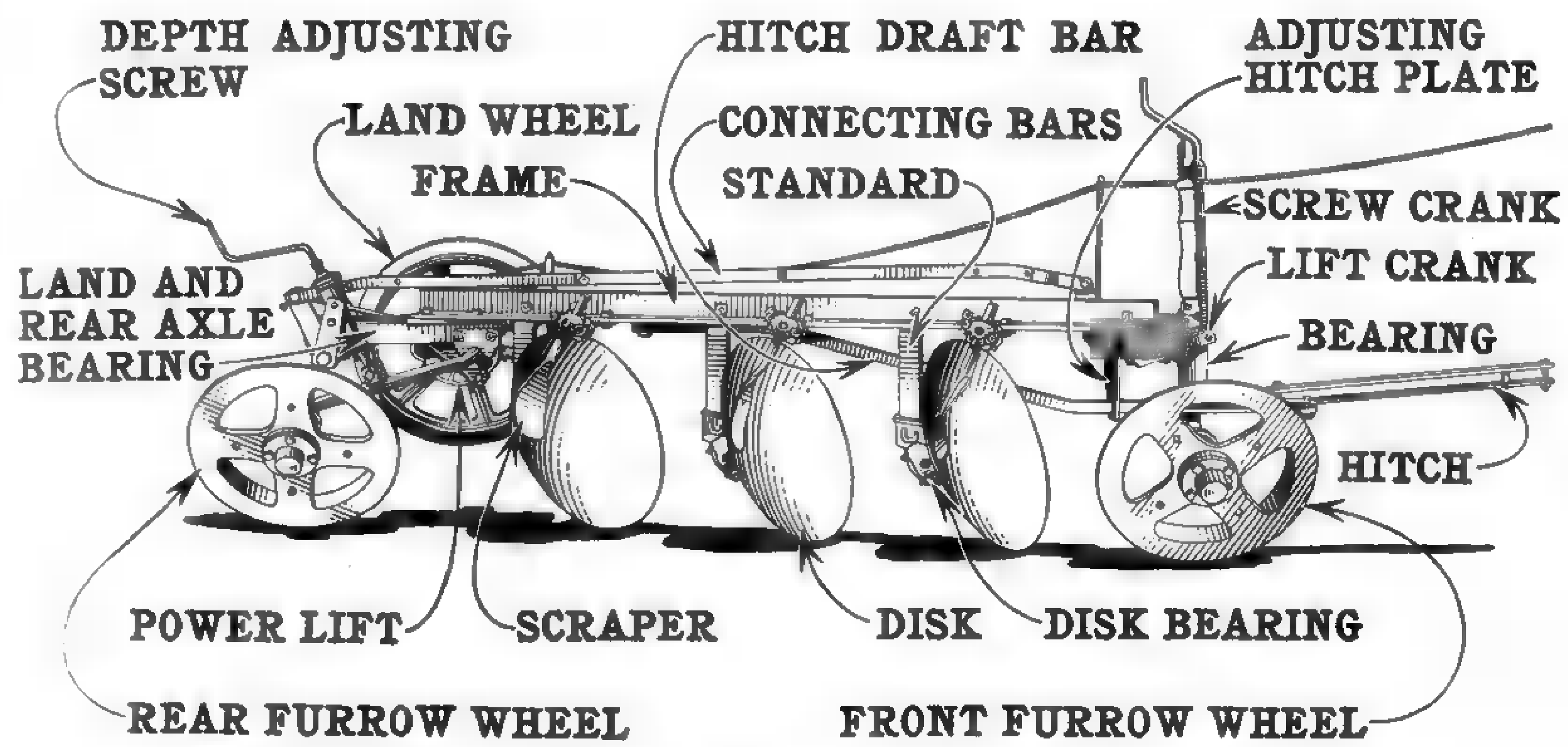


Figure 91—Tractor-drawn disk plow with important parts named.

adjustment of a simple eccentric to fix its proper relation to the level at which the disks run.

The front furrow wheel will run straight when the steering bar is adjusted properly so that front disk cuts full width. When opening lands, it is sometimes necessary to raise the furrow wheel higher than ordinarily required, by turning the screw crank depth adjustment. After opening lands, restore adjustments so that all disks cut uniform depth.

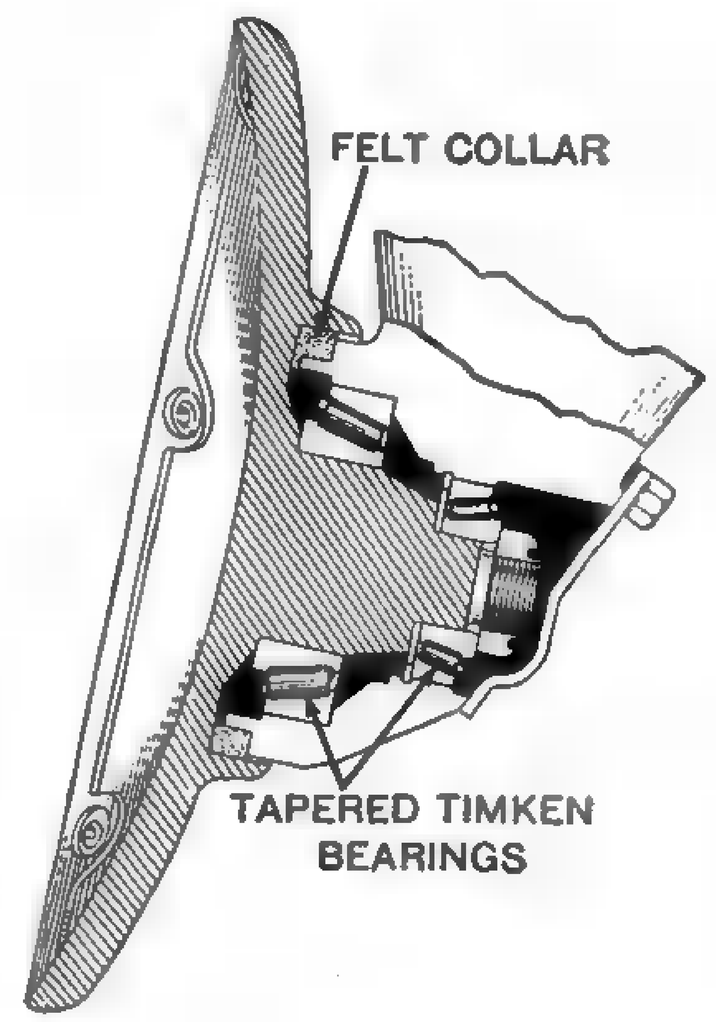


Figure 92—Showing cross-sectional view of roller bearing disk bearing with disk removed. Tapered roller bearings installed at spindle and shoulder carry the pressure of plowing with a minimum of draft. Expanding felt collar and overlapping flange on the disk spindle make this bearing dirtproof.

Scrapers must be set so they barely touch near the center of the disk, with the wing 1/4-inch from the surface. If set too close, excessive friction is created; if too far, they will not do a good job of cleaning.

Adjusting Load to Power. Practically all disk plows are convertible in number of disks used and the cut per disk, making it possible for the operator to fit the total width of cut to the power available and to soil conditions. In some of the larger heavy-duty plows, one disk may be removed and the remaining disks respaced, in which setting the plow cuts same width as before, but each disk takes a wider cut.

The standards to which the disks attach on the plow shown in Fig. 91 are bolted between two frame bars. They are adjustable vertically to provide three different angles of the disks to meet field and soil conditions. Width of cut per

disk is increased or decreased by changing the angle of the frame. This is done by shifting the rear frame.

Care Important. The disks of a disk plow are important factors in its operation. If they are kept sharp, polished, and properly adjusted, they cut and turn the furrow slices with the least possible draft. If neglected, they soon become the source of penetration troubles and poor work—the disk surfaces should be oiled when not in use. The wheel boxings should be kept well greased with a good grade of hard oil.

The roller bearing disk bearing, cross-section of which is shown in Fig. 92, does not require adjusting; it is lubricated by means of a pressure lubrication fitting.

Hitch Adjustments. The same relation between power and load that governs the hitching of moldboard plows applies to disk plows. The vertical hitch must be such that the pull of tractor holds the plow steadily to the depth set without raising or lowering the front end. A trial hitch

Figure 93—The semi-integral disk plow makes a compact, easily handled plowing unit with the general-purpose tractor.

and observation of results will indicate the proper hole in which to hitch.

The horizontal hitch should be as near as possible in direct line with the center of draft which is approximately the center of the total width of cut on any type of disk plow. Adjustment right or left may be necessary. In this case the furrow wheel may require adjustment so that the front disk cuts proper width.

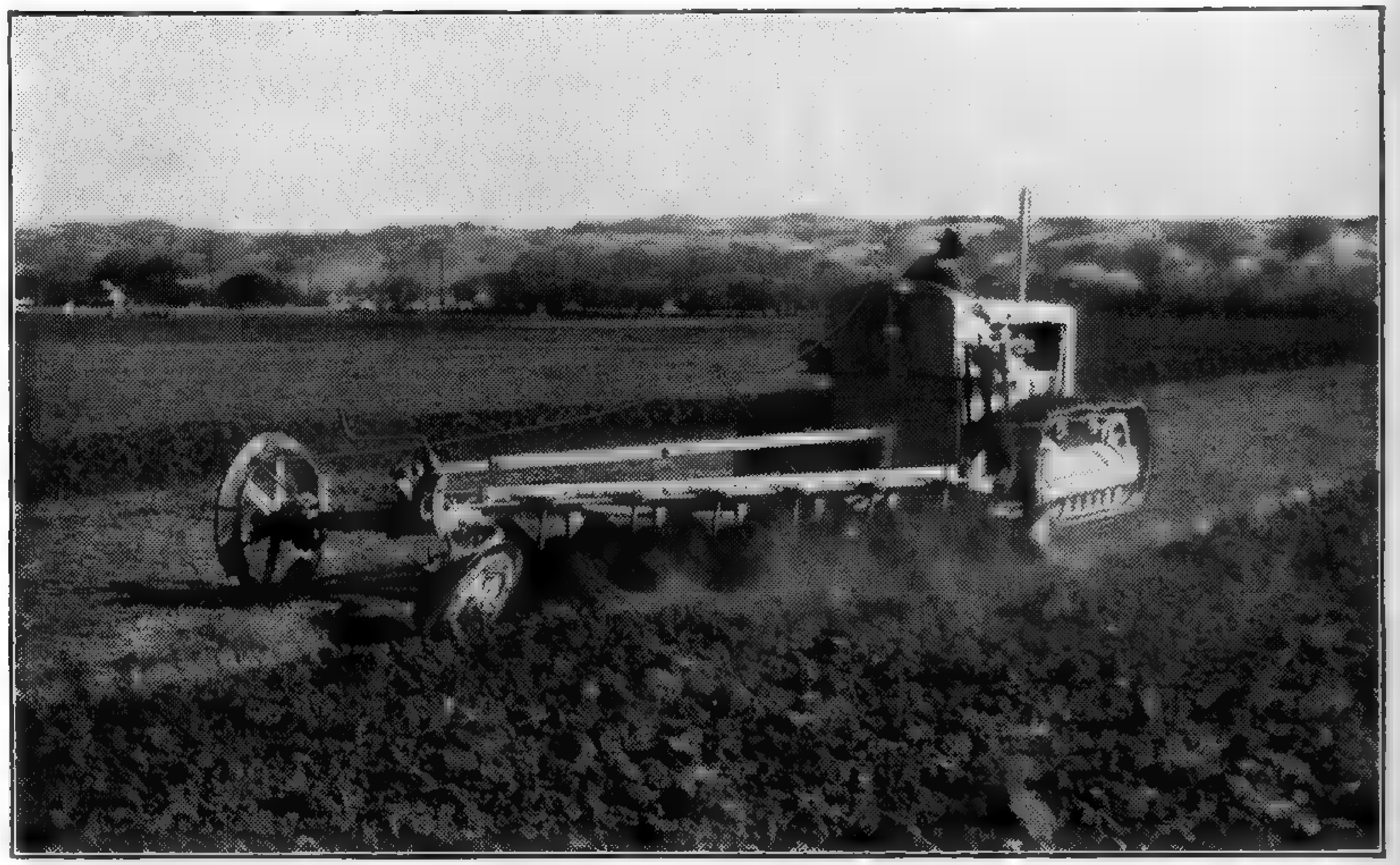


Figure 94—This heavy-duty disk plow, capable of working as deep [redacted] twenty inches, is preparing [redacted] seedbed in tough conditions.

Questions

1. *Under what conditions are disk plows used?*
2. *Name and describe two types of disk plows.*
3. *What is necessary to do an even job of plowing?*
4. *How would you increase or decrease the width of cut per disk?*
5. *What are the most important points in caring for a disk plow?*
6. *How would you obtain the proper hitch adjustment?*

DISK TILLERS

The disk tiller (see Figs. 95, 96, 97, and 98) is similar in operation to the disk plow. Introduced originally as big-capacity, time-saving tillage equipment for the winter wheat growers, it has gained great popularity with general farmers in many parts of the country. Once over, after harvest, puts the land in condition for planting in some sections; in other sections, it is common practice to till the ground once after harvesting, and again just before planting.

The disk tiller has proved so successful in many general farming sections that its use is no longer restricted to one territory—a fact which has resulted in the development of tillers in various sizes and in modified types to take care of a wide range of uses in weeding, seedbed preparation, working fallow ground, building and maintaining terraces, etc. Seeding attachments are available for many tillers, thereby broadening the usefulness of this versatile equipment.

The kind of work a disk tiller will do depends much upon the condition of its disks and bearings. Disks must be sharp

Figure 95—Disk tiller equipped with hydraulic cylinder for control from tractor seat.

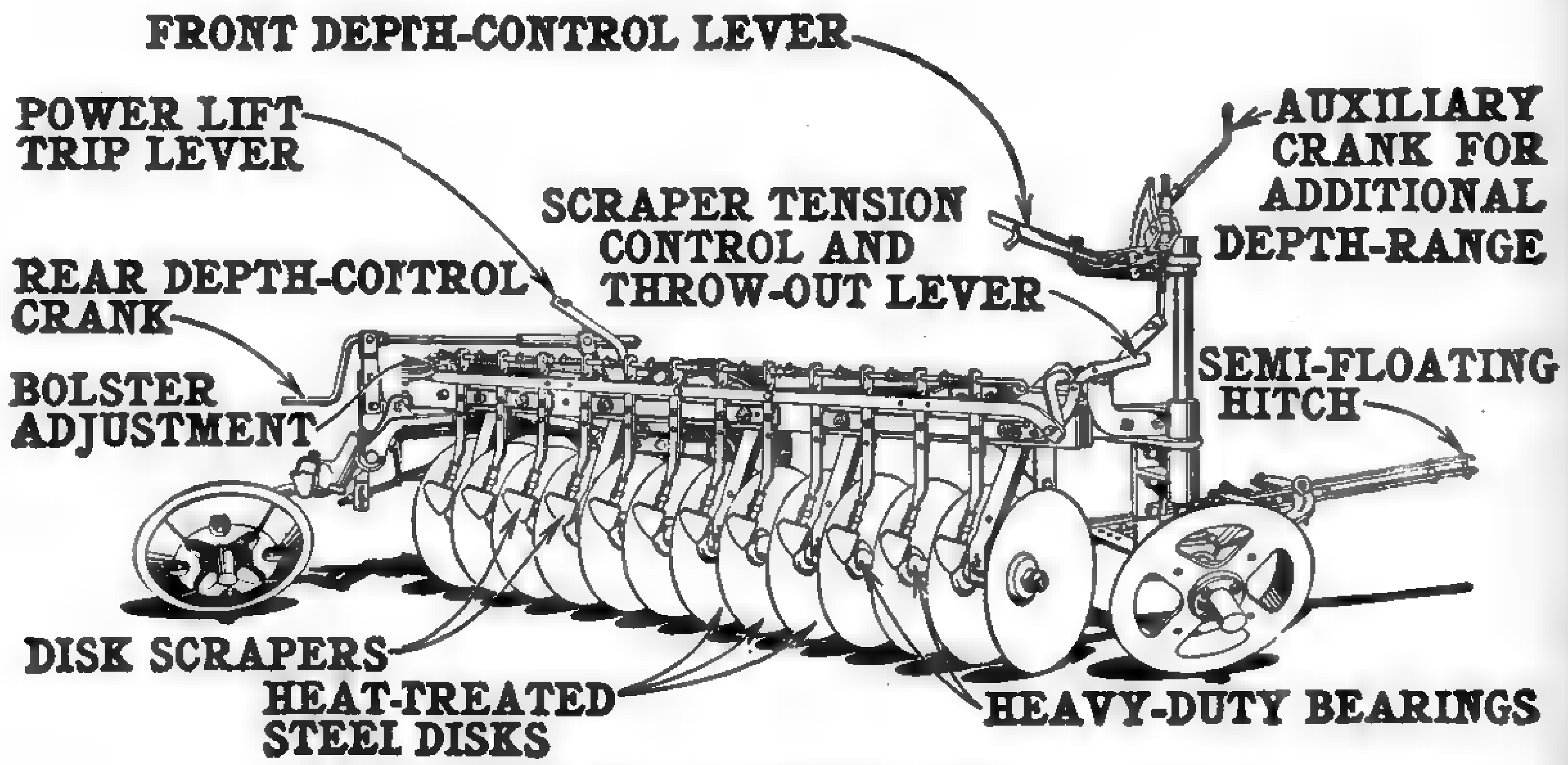


Figure 96—Disk tiller, used in many tillage operations.

to cut the stubble and trash. Their bearings must be well oiled to withstand the heavy work to which they are subjected.

Adjustment and operation of the tiller are comparatively simple. The fundamental principles which govern proper hitching of a plow apply to the disk tiller.

In the field, a long lever at the front, supplemented by an auxiliary crank for additional range, controls depth of the front furrow wheel. This control device provides plenty of adjustment for opening up land. An easily operated screw crank at the rear acts upon both the land and rear wheels. Once leveled to the proper depth, no further adjustment is necessary as the power lift raises the disks or drops them to work when turning at the headlands. The correct hitch is on a straight line between center of draft and point of attachment to tractor. A trial will usually show where the hitch should be.

The adaptability of hydraulic control through the remote cylinder is especially important to the operation of a disk tiller (see Fig. 95). With this control, the operator may vary the depth instantly to meet field conditions as the outfit moves over the field. The remote cylinder, of course, is used to raise and lower the tiller in addition to its function in making field adjustments.

Figure 97—Disk tiller at work. Note how stubble is mixed with the surface soil, forming a mulch.

A bolster adjustment on the rear of the tiller, shown on the preceding pages, provides adjustment for changing the angle at which the disks work. By means of this adjustment, any working angle required to meet conditions ranging from soft, loose soil, to hard, dry ground can be obtained. The rear

Figure 98—A disk tiller working on terrace construction.

frame is definitely marked with settings for three soil conditions: "soft or stony ground," "medium ground," and "hard ground."

The rear gang of three disks on the tiller, shown in Fig. 96, may be removed to reduce the load where field conditions are unusually difficult. This reduces the width of cut, lessening the power required. Many of the smaller tillers are reducible in size in the same manner although the smallest sizes, built for the small tractors, are reducible in cut by varying the angle of the disk gang only.

Questions

1. *Describe the disk tiller, its advantages and uses.*
2. *How is depth controlled on the tiller shown?*
3. *What is the purpose of the bolster adjustment?*
4. *Why is hydraulic control especially valuable in the operation of the disk tiller?*

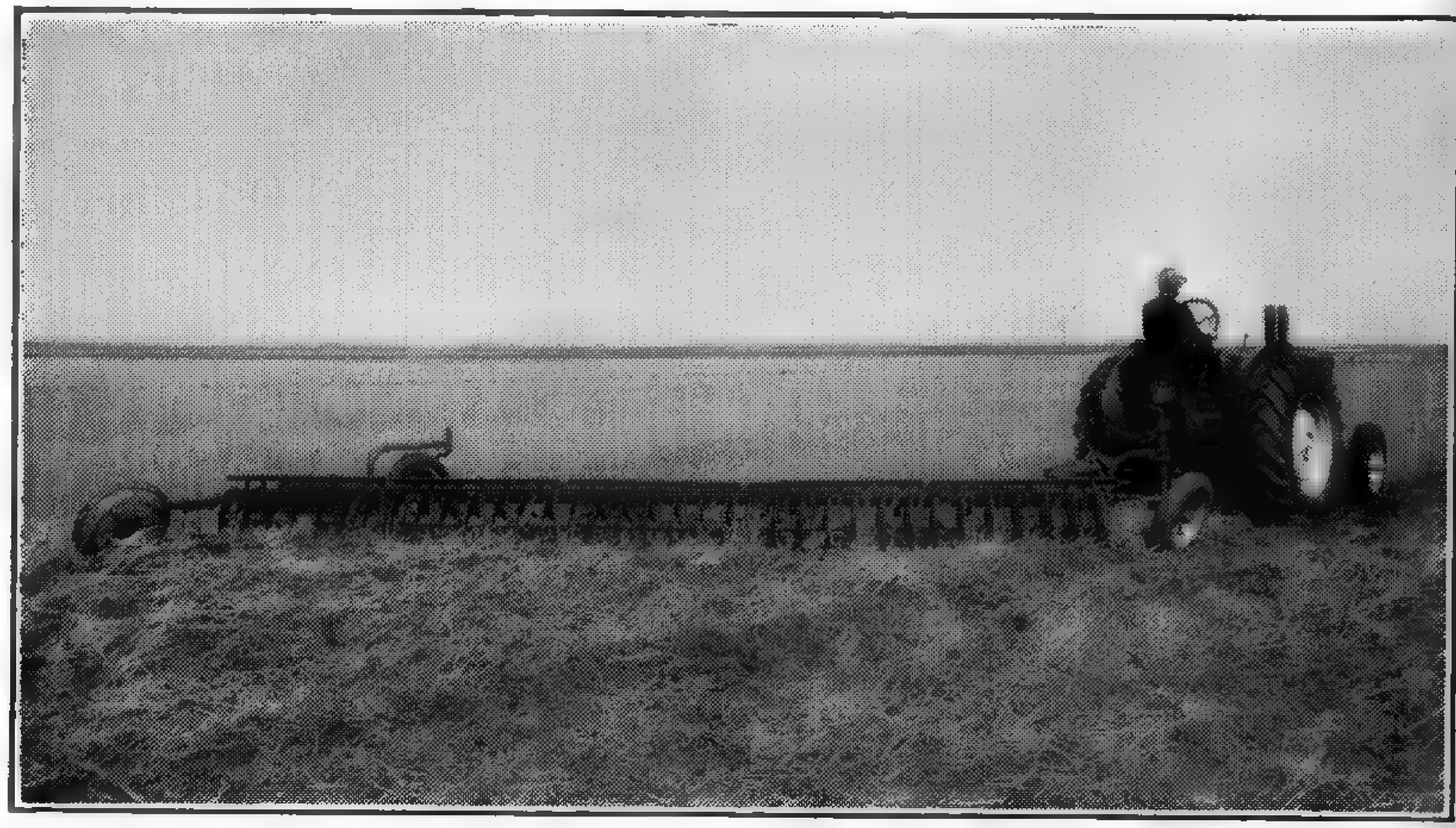


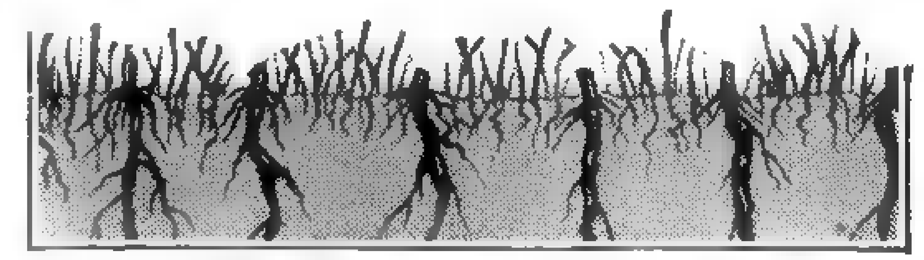
Figure 99—The larger tiller with independent gangs linked together permits big-capacity operation and ground-hugging flexibility. Shown above with a standard-type Diesel tractor.

Chapter III.
DISK HARROWS

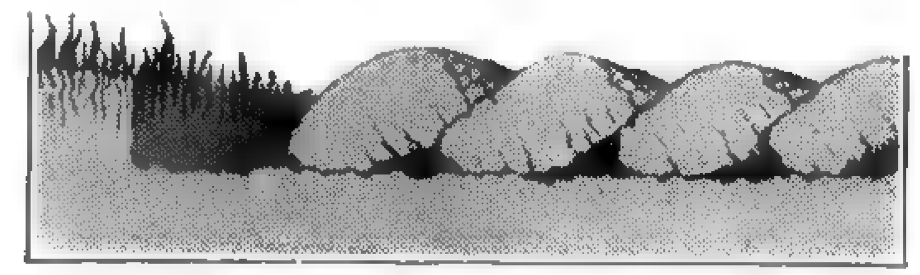
The function of the disk harrow is to pulverize and pack the soil, leaving a surface mulch and a compact subsurface. It is used to good advantage before plowing to break the surface and mix the trash with the topsoil and, after plowing, to pulverize lumps and close air spaces in the turned furrows. Although it is not to be found on every farm, there are few general farmers who would not profit by its use. Fig. 100 illustrates the value of a disk harrow when used before and after plowing.

Types of Disk Harrows. Disk harrows are made in two types: single-action and double-action. The single-action harrow, shown in Figure 103, is a big-capacity harrow for roughing grain stubble, working summer-fallow land, etc. Some types of single-action harrows can be converted to double-action harrows.

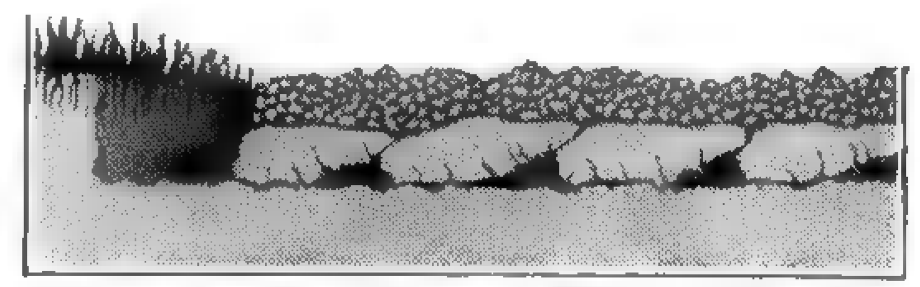
The double-action harrow, ideal for general seedbed preparation, is available in two general types: the four-gang type, as shown in Figure 101, and the offset type, shown in Figure 102. The offset harrow is particularly adapted for disking in orchards and groves as well as for seedbed preparation. It can be offset right or left to work close to the trees



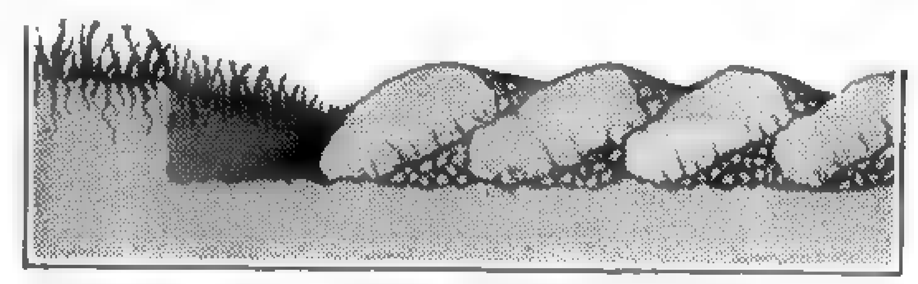
Sun-baked stubble land.



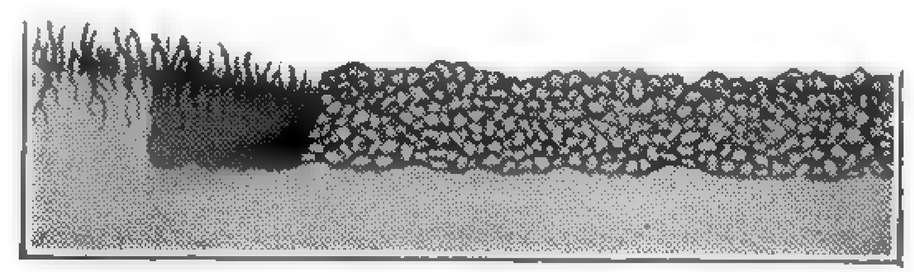
Plowed, but not disked.



Disked after plowed, but not before. Notice air spaces.



Disked and then plowed. Good contact with subsoil.



Disked before and after plowed. The ideal seedbed.

Figure 100—Drawings illustrating the value of disking both before and after plowing.

while the tractor operates in the open, away from low-hanging branches. Heavy-duty models are available for use in soil conditions or heavy cover crops where extra weight and strength for deeper penetration are of great importance.

Both four-gang and offset harrows are available in wheel-carried models. (See Fig. 104.) Transporting this type of harrow from one disking job to another is a very simple operation.

Requirements for Good Work. To do a good job, the disk harrow, first of all, must penetrate well and evenly over its entire width. In the case of two-section harrows, both sections must meet these requirements, the disks of the rear section cutting the ridges left by the front disks instead of trailing in their furrows.

Flexibility has much to do with even penetration and good work. When the gangs of each section work independently, one gang may pass over stones or stumps and conform to irregularities in the surface of the field without hindering the work of the other gangs.

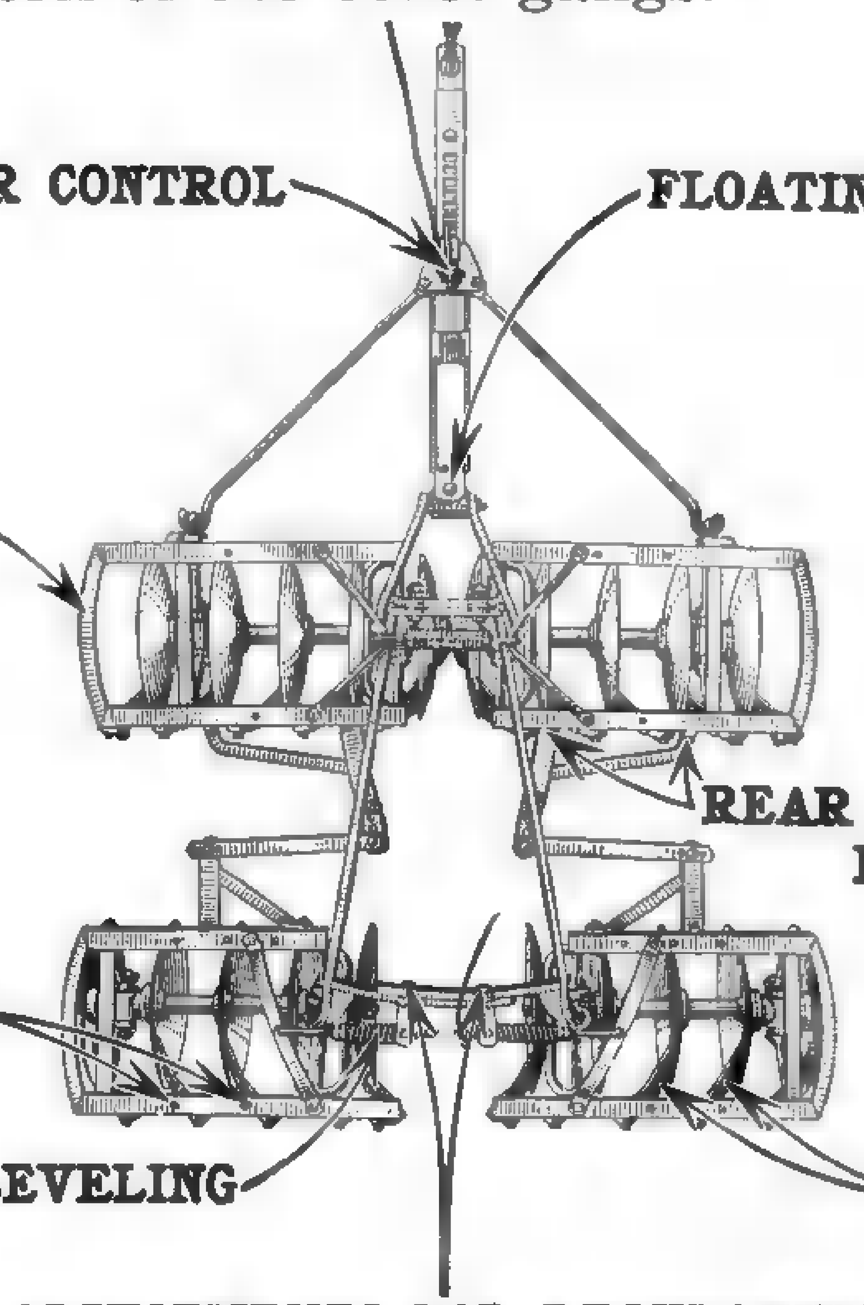


Figure 101—A double-action, tractor-controlled disk harrow.

Uniform penetration is most important in the proper functioning of a disk harrow. Securing good penetration depends upon several factors.

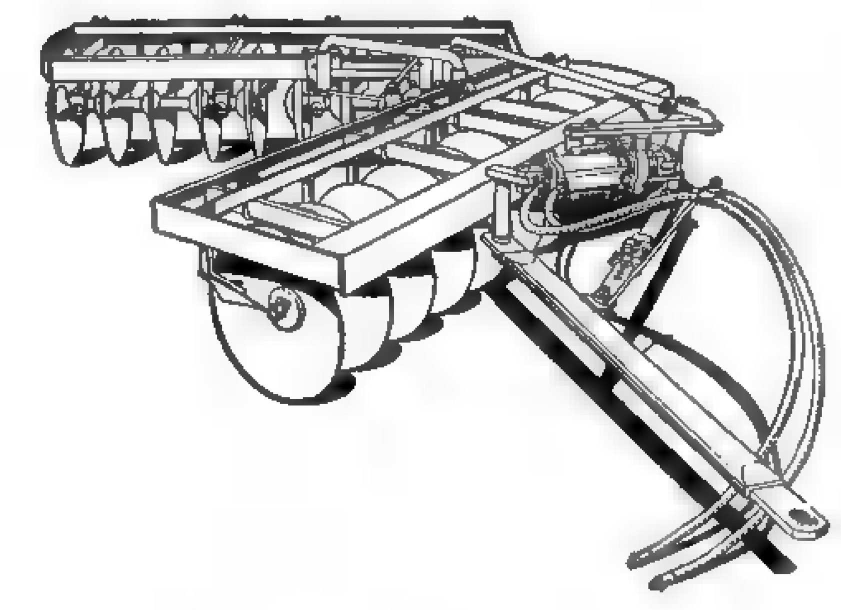


Figure 102—The heavy-duty offset disk harrow.

The design of the harrow is of utmost importance, for good design presupposes proper distribution of weight with ample strength to meet field conditions. Present-day harrows, reflecting the trend to improved manufacturing methods are, in many cases, lighter in weight than were the earlier harrows; however, through improved design they have greater strength and will penetrate and hold to their work effectively. Weight crates or platforms are provided on most modern harrows so that additional weight may be used where difficult conditions require it.

Operation and Adjustments. Penetration of most disk harrows is obtained by angling the disks, the angle necessary for good work depending upon the condition (or texture) of the soil and the amount of trash to be cut. On most double-

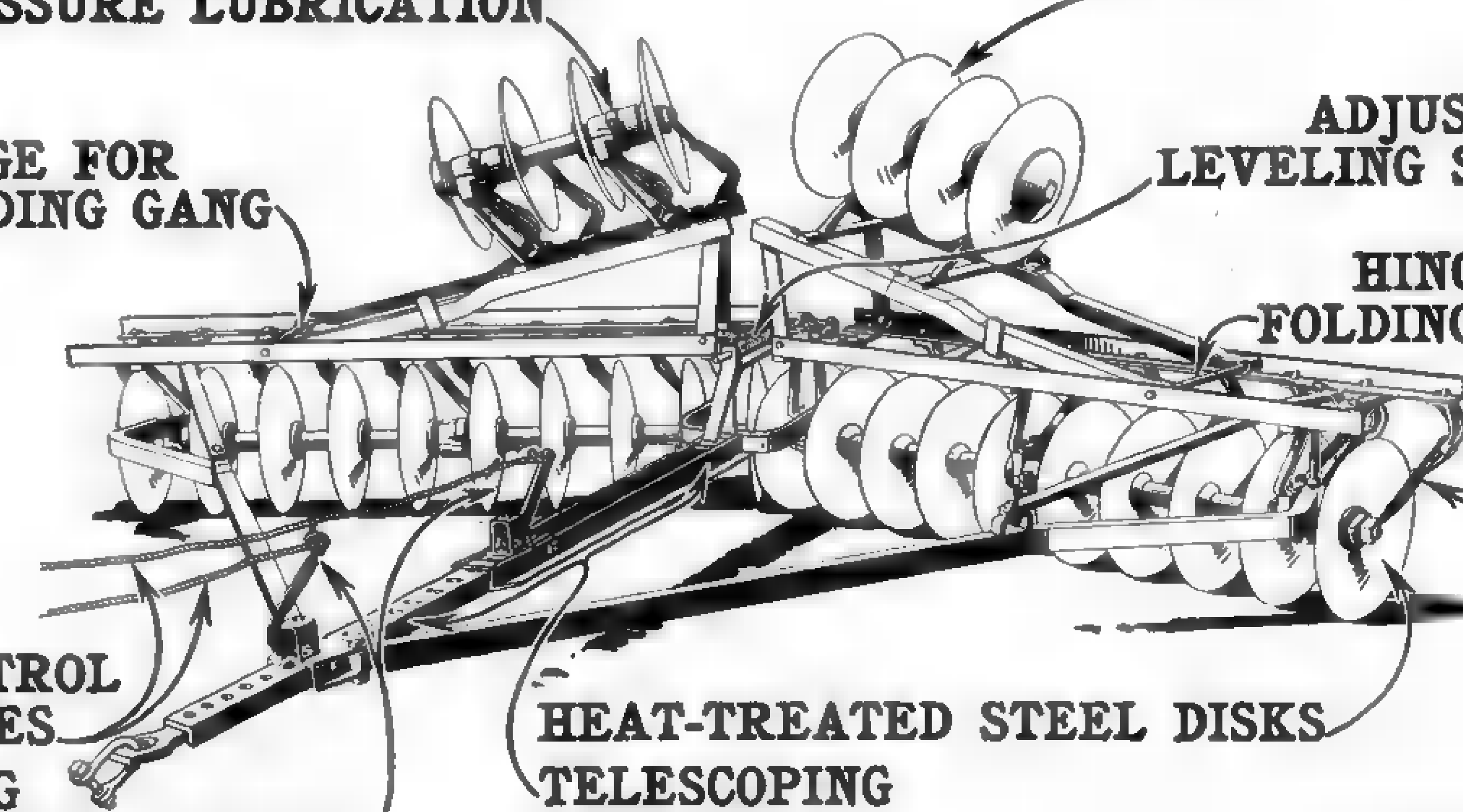


Figure 103—Single-action tractor-controlled harrow with end gangs folded over.

action disk harrows, provision is made for angling the disks for maximum penetration which is obtained at an angle of approximately 20 degrees. This angle is considerably more in an offset-type harrow.

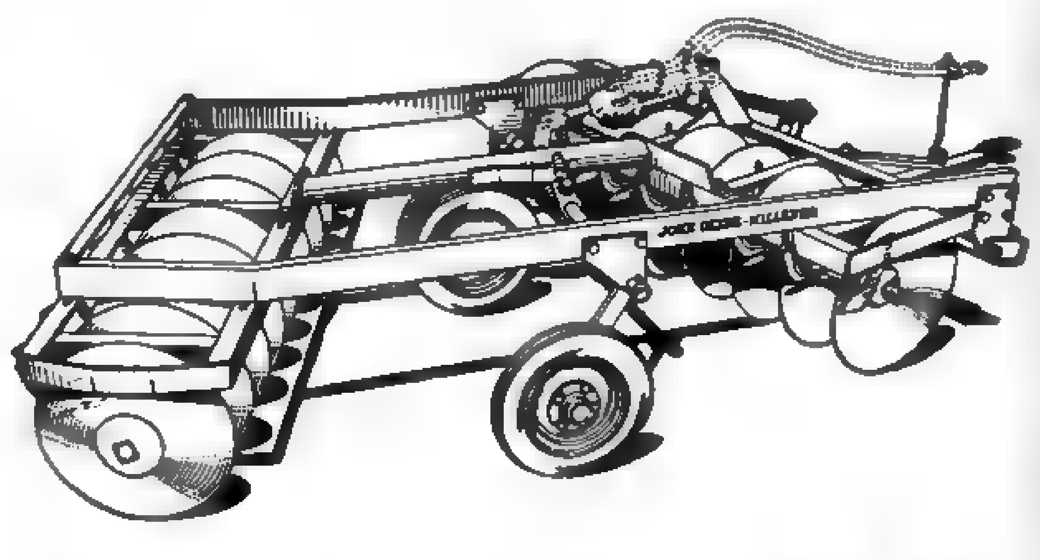


Figure 104—In the wheel-carried disk harrow, wheels act as depth gauges to limit penetration of gangs and as transport wheels. Harrow shown is a fixed-angle offset type.

Angling of the gangs of both single- and double-action harrows is accomplished by means of a trip rope, within easy reach of the tractor operator, or by hydraulic power, as shown in Figure 105. Gangs in the rope-controlled harrow can be straightened on the forward pull if crossing a grassed waterway or if in danger of stalling the tractor. Front and rear gangs of some types of double-action, four-gang-type harrows can be angled independently of each other.

Hydraulic control, as applied to the disk harrow, enables the operator to angle, straighten, or set the gangs at any

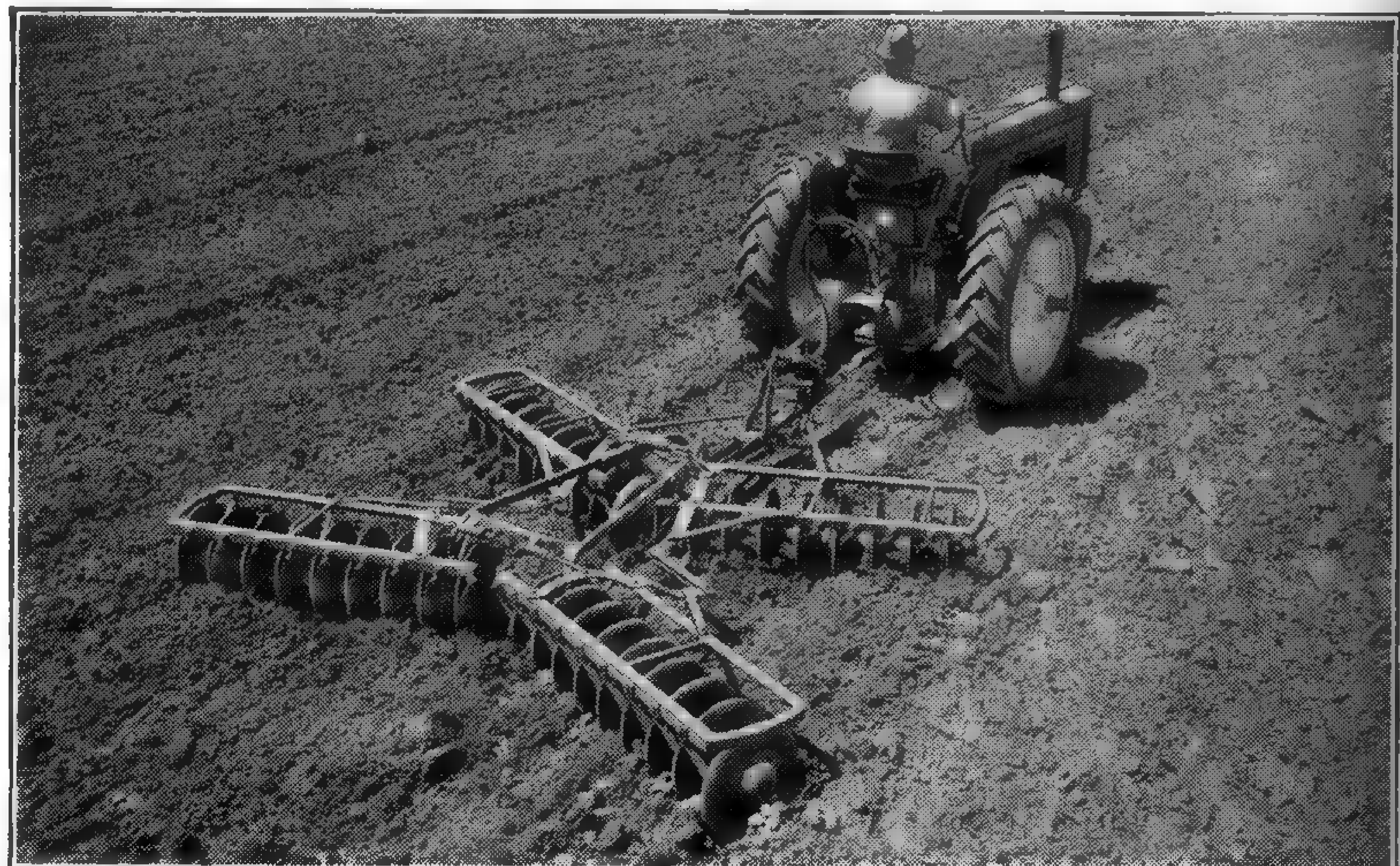


Figure 105—A double-action harrow equipped with hydraulic control.

in-between working position without stopping, backing, or slowing down. Hydraulic control is particularly advantageous when disking over grass waterways and in turning at headlands.

The end gangs of the single-action harrow, shown in Fig. 103, can be folded over when going through gateways, or to provide additional weight for better penetration in difficult conditions. In this way, a 15-foot harrow can be narrowed to 10-1/2 feet, and a 21-foot harrow to 14 feet. The single-action harrow may be used for double-disking by lapping half the width of the machine each time across the field.

The scrapers are adjustable to suit soil conditions. Scrapers on both sections of the double-action tractor harrows, shown, can be oscillated by means of ropes, without leaving the tractor seat. Provision is made for locking scrapers at the edges of disks or for locking them away from disks when not needed.

Good Care Lengthens Life. The efficiency and length of service of a disk harrow depend upon the care given it.

A hydraulically controlled offset disk harrow preparing a seedbed.

First in importance is thorough greasing of the bearings. Many of the modern disk harrows, especially the tractor types, are equipped with fittings for pressure lubrication, making it an easy matter to keep the bearings well oiled. Where hard oilers are used, cups should be kept full of a good grade of hard oil and should be turned down at regular intervals. The bearing bushings are provided with fittings for grease-gun lubrication to make thorough lubrication an easy servicing job.

A good cutting edge on all disks is desirable, especially in hard ground and trashy conditions. Most disk blades are now made of tough steel, then heat-treated to hold a long-wearing edge.

During slack seasons, go over the entire disk harrow, tightening bolts, replacing worn parts, and getting the implement ready for the next season's work. Keep disk blades well greased with a good hard oil when harrow is not in use.

Questions

1. *What is the function of the disk harrow?*
2. *Why should it be used both before and after plowing?*
3. *What is the first requirement of a disk harrow?*
4. *What is meant by "flexibility" and why is it desirable?*
5. *How is a disk harrow made to penetrate?*
6. *How are the scrapers oscillated?*
7. *Why is it necessary to keep the disks sharp?*
8. *Name the different types of harrows and their special uses.*
9. *What is the best type of harrow for use in your farming area and why?*

Chapter IV.
HARROWS, PULVERIZERS, AND FIELD CULTIVATORS

Methods of finishing the seedbed vary according to soil conditions and established practices in different sections of the country. While the spike-tooth harrow is used in practically every section, the spring-tooth harrow, pulverizer, and field or tool-bar cultivator are not in such general use. For that reason, the discussion of those implements will be brief.

Spike-Tooth Harrows. Fig. 106 shows a popular style of spike-tooth harrow. The operation and adjustment of a harrow of this type are comparatively simple, there being no field adjustment other than setting the slant of the teeth with the levers provided. The degree of adjustment is governed entirely by field conditions.

Each tooth of this harrow is fused by electrical induction into the tooth bars and actually strengthens the tooth bars.

This harrow is equipped with a cushion relief spring which permits the teeth to flatten enough to clear obstructions in the field. This action also helps the teeth to clean themselves of trash.

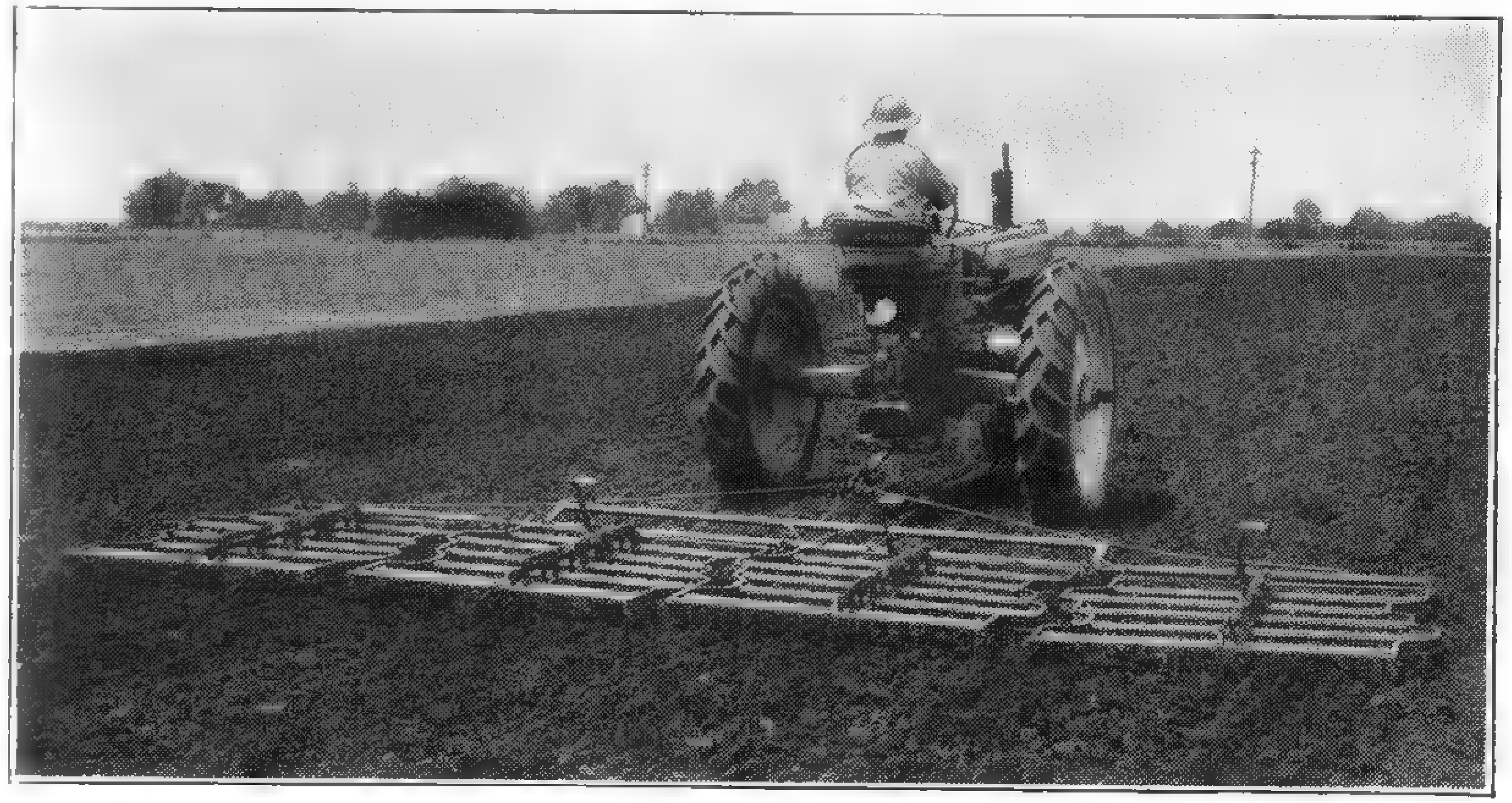


Figure 106—Welded four-section spike-tooth harrow.

Spring-Tooth Harrows. The fact that spring-tooth harrows will penetrate to a greater depth than spike-tooth harrows, makes them better adapted to the requirements of certain sections. They are used also, with great efficiency, in the eradication of noxious weeds and grasses.

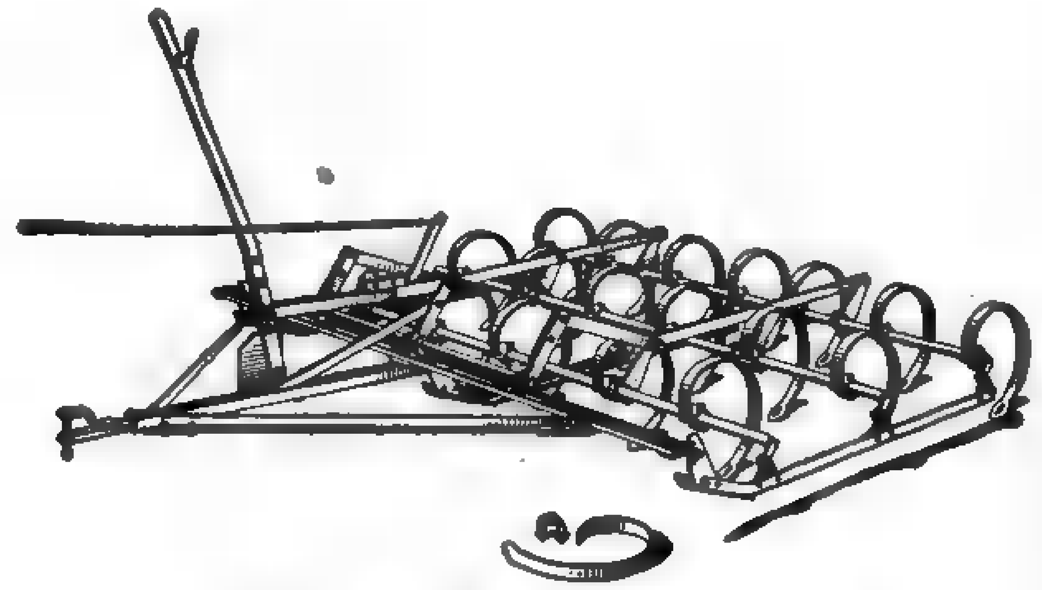


Figure 107—A tractor-controlled spring-tooth harrow.

Fig. 107 illustrates a tractor spring-tooth harrow that is controlled from the tractor seat. A trip rope is provided for dropping the teeth to work and raising them out of the ground, depth being determined by previous setting. In addition to this depth adjustment, the individual teeth may

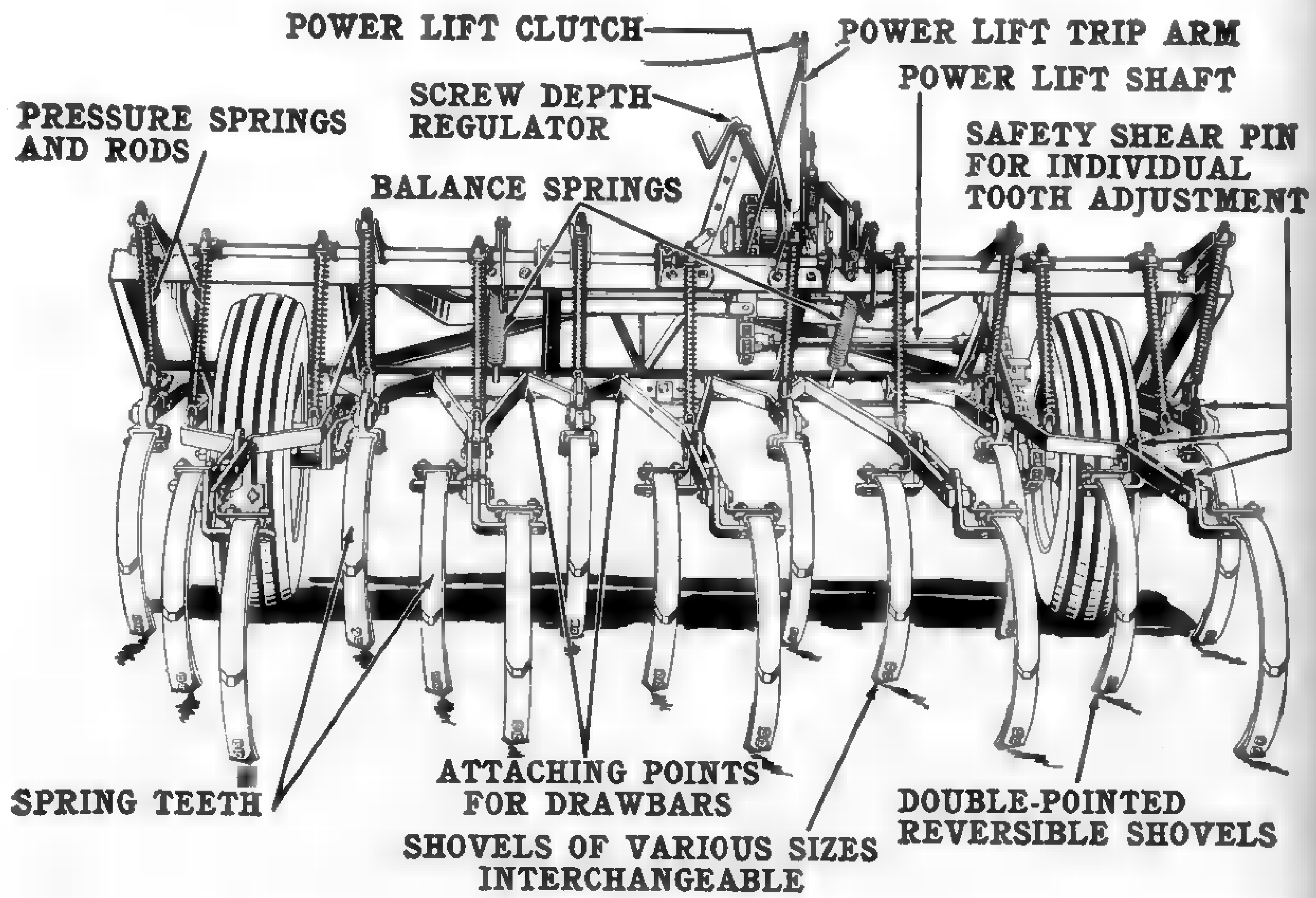


Figure 108—Field and orchard cultivator with tractor hitch and screw-type depth regulator.

be adjusted in the clamps for finer depth adjustment or to vary the penetration.

Several styles of teeth may be obtained for different purposes such as cultivating alfalfa and digging out quack-grass roots, in addition to the type used as a seedbed finisher.

Field and Orchard Cultivators. Because of its great diversity of uses, the field cultivator is used extensively in both the United States and Canada. The type shown in Fig. 108, low-down, with wheels set inside the frame, is ideal for working close to trees, fences, and ditches.

It is used for preparing fall-plowed land for spring seeding and for tillage work in regions where summer-fallowing is practiced. Breaking up sod with the cultivator, prior to plowing, often results in a better plowing job. It does good work as a weed destroyer, eradicating quack-grass, thistle, wild Morning-Glory, and other weeds. Integral field cultivators of this type are available.

The field cultivator, shown in Fig. 108, may be used with

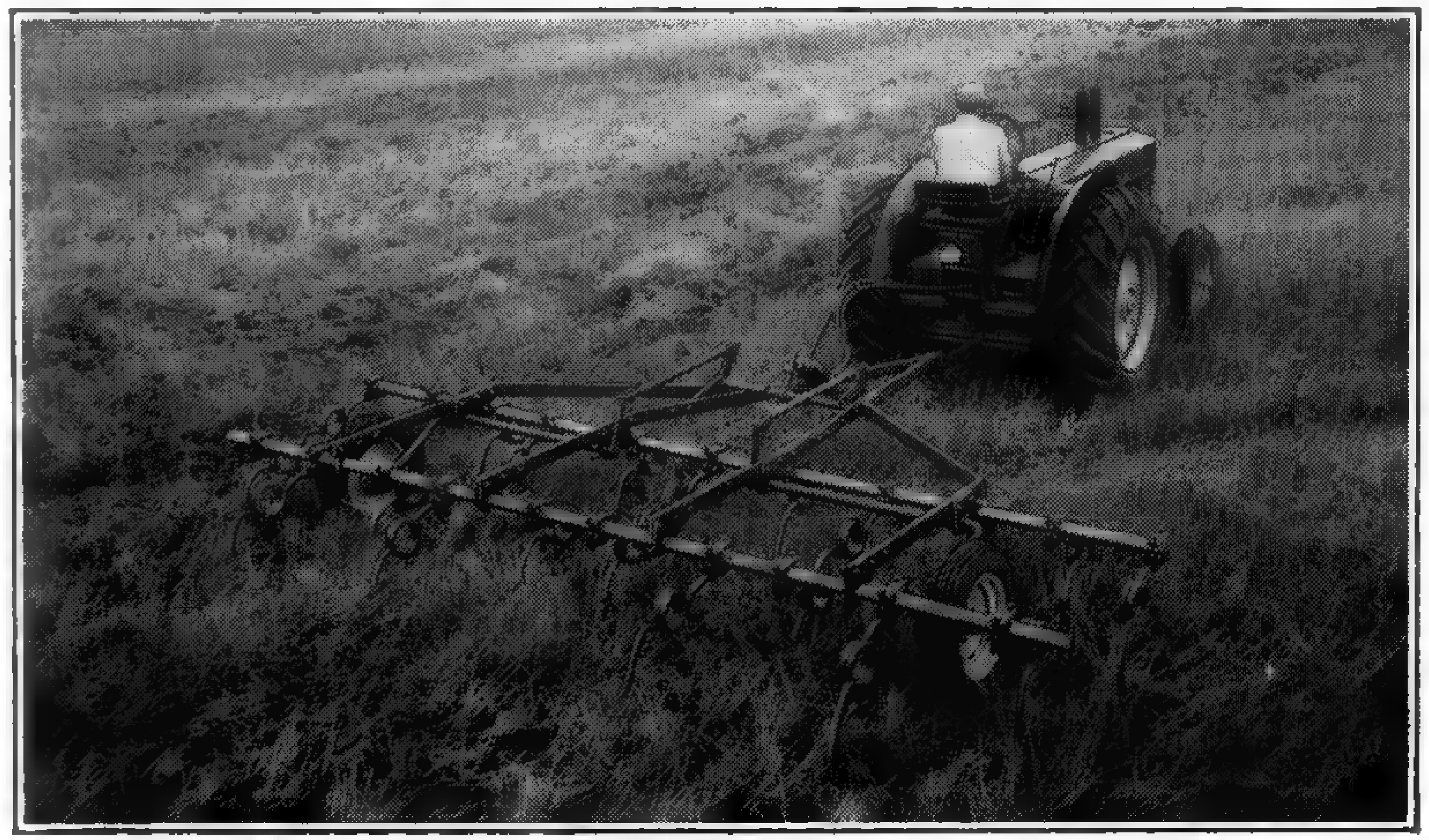


Figure 109—The tool carrier with coil-spring standards destroying surface growth.

either stiff or spring teeth and with different kinds and sizes of shovel points. It is simple to operate; there are few adjustments. Teeth are raised and lowered by means of a power lift operated by a trip rope from tractor seat or by hydraulic power from the tractor power lift through a remote cylinder. Crank-type depth regulator gives tractor operator constant depth control.

Frequent sharpening of the shovels, and keeping them coated with a good hard oil when not in use, will aid in making the cultivator pull light and do good work.

Similar to the field cultivator, the sub-surface tool carrier (Fig. 109) is designed for the heavier tillage work. Working equipment, shovels, sweeps, spring teeth, etc., is quickly interchangeable on the long tool bars. Spacing of equipment is varied by shifting the tool clamps. Like the field cultivator discussed above, the carrier is raised and lowered by a power lift built into the wheel or by hydraulic power which permits the operator to raise, lower, and make field depth changes from the tractor seat. The carrier requires little field servicing other than periodic lubrication.

Soil Pulverizer. Ideal for finishing the seedbed and valuable for use in growing crops, the soil pulverizer or packer, is more widely used each year. It is simple and easy to operate. There are no adjustments; few parts need replacing, with exception of the oil-soaked wood boxings, which are easily removed and replaced at small cost.

Questions

1. *What implements are used for finishing seedbeds in your community?*
2. *What adjustment can be made on the teeth of the spike-tooth harrow shown?*
3. *To what conditions are spring-tooth harrows especially adapted?*
4. *Describe a field cultivator and its uses.*
5. *For what purposes is the tool carrier used? How does it differ from the field and orchard cultivator?*
6. *Why is the soil pulverizer a valuable implement for finishing the seedbed?*

PART THREE
PLANTING

The necessity of planting all crops at the proper depth and distributing uniformly the right amount of seed to suit soil conditions is readily apparent to all who have had experience in growing products of the soil.

If seed is planted too deep or too shallow, too thick or too thin, if the row planter skips hills or the grain drill leaves strips unplanted, the yield is bound to be reduced accordingly. If planted accurately, with the per-acre quantity carefully measured to suit the richness of the soil, maximum yields will result, provided, of course, other conditions and practices are correct.

The farmer who understands and gives careful thought to the adjustment and operation of his planting equipment will profit greatly. The operation of planting equipment should be studied carefully by the students of agriculture and farm mechanics.

Chapter V.
GRAIN DRILLS

Grain drills have been improved greatly during the past few years. Perhaps the most notable improvement is the steel box. Not only does the steel construction give greater strength and durability, but it also makes possible an enormous increase in capacity, in some cases, as much as 72 per cent more than that of the wood box.

Like plows, grain drills are built in many different styles with a variety of equipment to meet conditions in every section of the country. In some sections, the single-disk furrow opener will work better than the double-disk, while other conditions may demand a hoe-type opener. The big farm regions require big-capacity tractor-drawn drills while the small farmers of the East or South need smaller sizes. Many farmers in the larger wheat-growing sections prefer the double-run feed type of drill. In semi-arid regions, where

every available bit of moisture must be conserved, the semi-deep furrow drill with its large disks solves the problem by placing the seed considerably deeper than the ordinary drill, thereby assuring contact with the moist soil found at greater depth.

In territories where soil blowing is a serious problem, the deep furrow drill, with moldboards which throw the soil one way (Fig. 113) or the lister drill (Fig. 111) serves the purpose of deep planting and, at the same time, leaves the surface soil ridged to prevent or reduce soil drifting and seed blowing. But, whatever the preference may be, or conditions demand, it is usually found that manufacturers build a drill that meets the requirements satisfactorily.

Types of Drills. There are two principal types of end-wheel grain drills—the fluted force-feed and the double-run-feed. Of these, the fluted force-feed drill (see Fig. 110) is used most generally and is available in a variety of styles. Most favored of this type is the combination grain and fertilizer drill which can also be equipped with a grass seed attachment.

Fluted force-feed drills are also available as straight grain

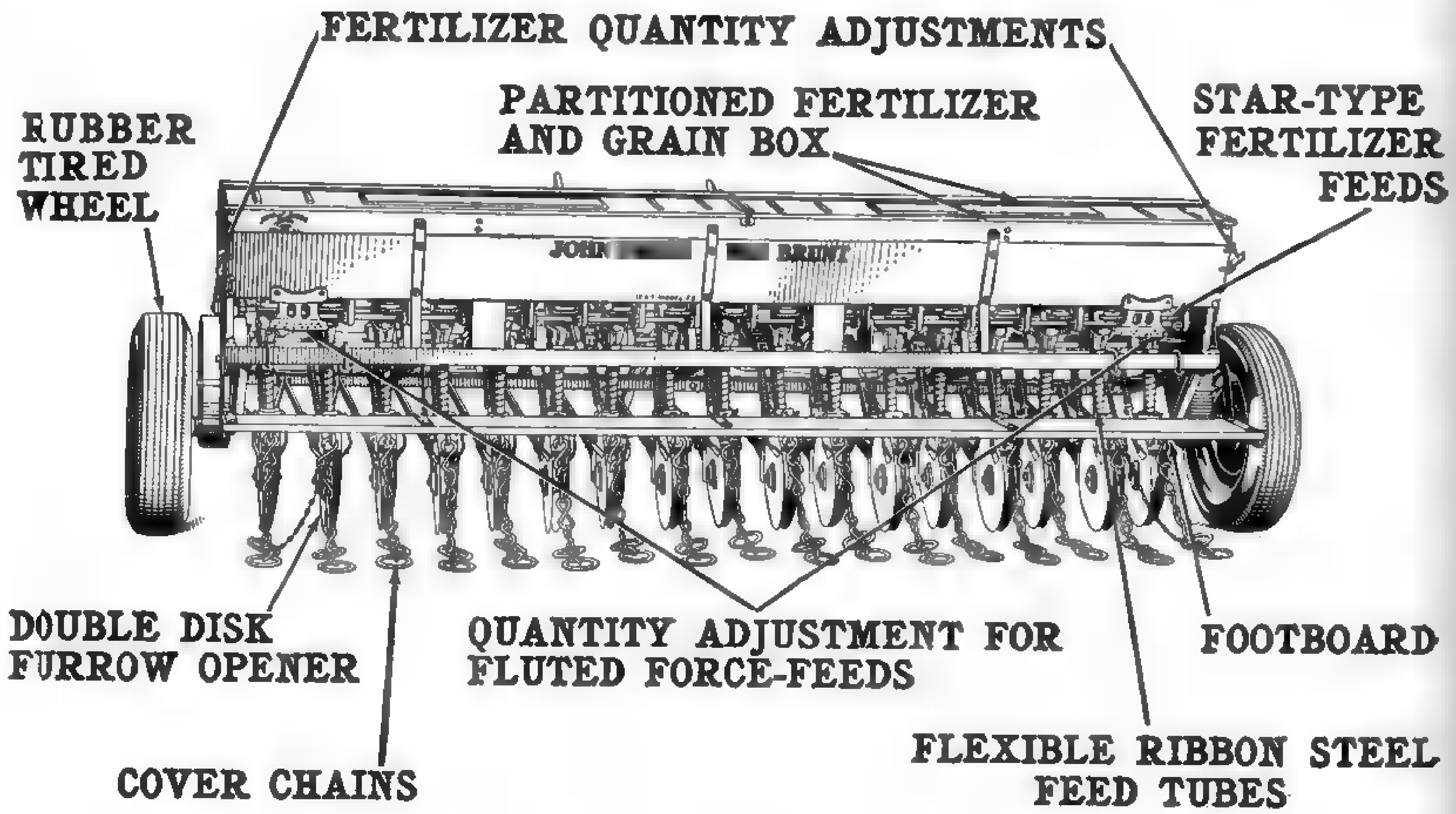


Figure 110—Rear view of grain drill equipped with double-disk openers.

drills, low-down press drills which have press wheels that firm the soil over the seed to encourage germination and to keep soil from blowing, lister-type drills for use in stubble-mulch farming, and plow press drills which attach behind the plow. With the plow press drill, a pulverizer is often used between the plow and drill, making a 3-way hookup for plowing, pulverizing, and seeding in one operation.

In recent years, the lister-type drill (see Fig. 111) has given tremendous advantage to farmers in the northern wheat states where every precaution must be taken against wind and water erosion as well as drouth. Without displacing the mulched topsoil, the lister-type openers (see Fig. 119), place the seed on the bottom of a wide furrow and leave wind-breaking ridges of a size to suit conditions. Seed is placed deep enough to take full advantage of the soil moisture. Press wheels squeeze air spaces out of the seedbed and pack the soil over the seed; there is just enough compactness to permit the young plants to break through easily.

Fertilizer-Grain Drills. This style of drill completes four operations at once. It pulverizes the soil, plants seed, distributes fertilizer, and covers both. Farmers who find it necessary to sow fertilizer on their fields are able to make a big saving in time by using a fertilizer drill, sowing the

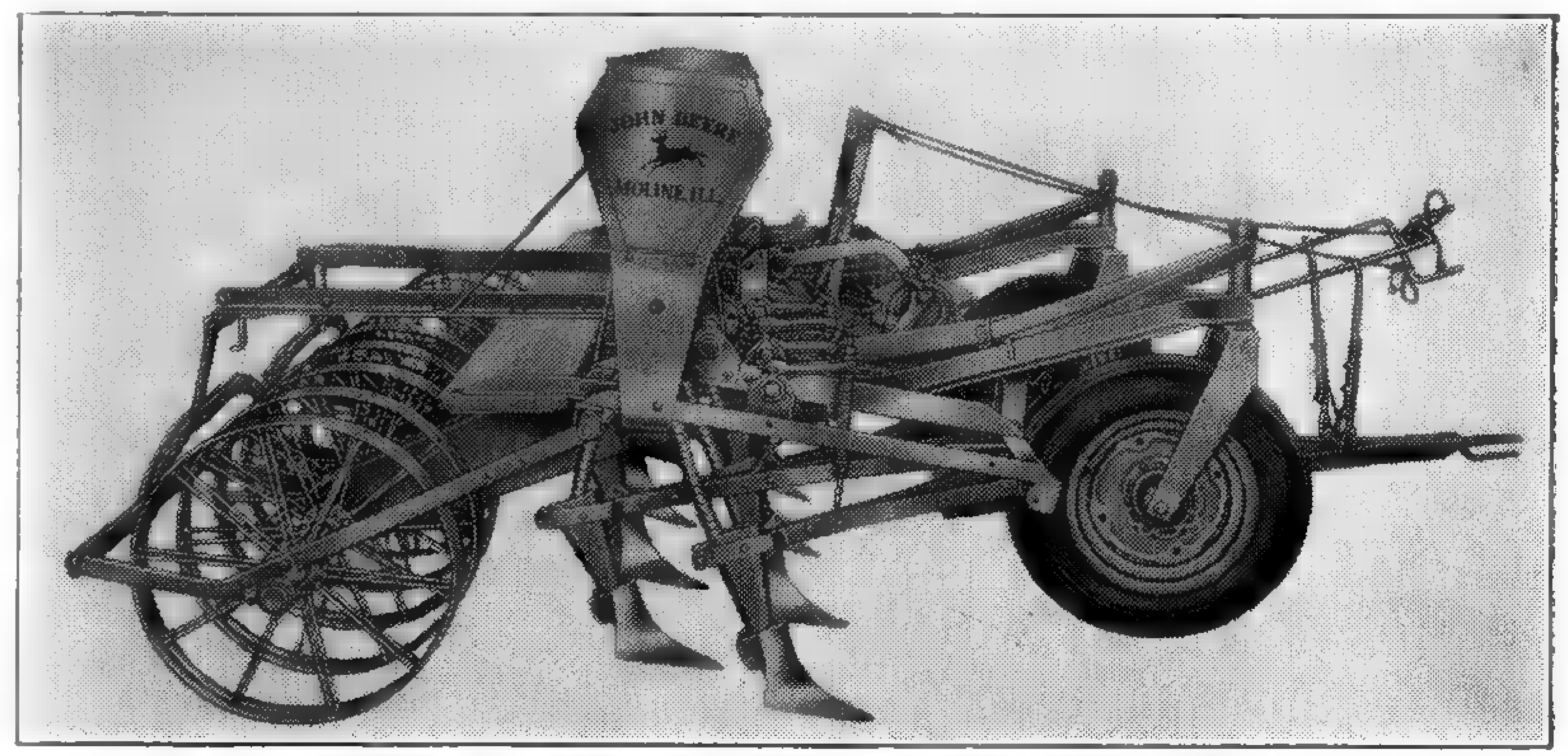


Figure 111—Side view of the lister-type grain drill.

fertilizer and seed in one operation.

Fertilizer drills have two distributing units—one for seed and one for fertilizer—although both seed and fertilizer are released through the same tube. A third unit, for grass seed, is also available. The planting unit, which consists of the regular fluted feed drill mechanism, illustrated in Fig. 114, is built into the front half of the seed box. The fertilizer feed distributes any amount of fertilizer from 24 to 1,680 pounds per acre. Star feeder wheels rotate in the fertilizer box and cause an even flow of material into the seed tubes.

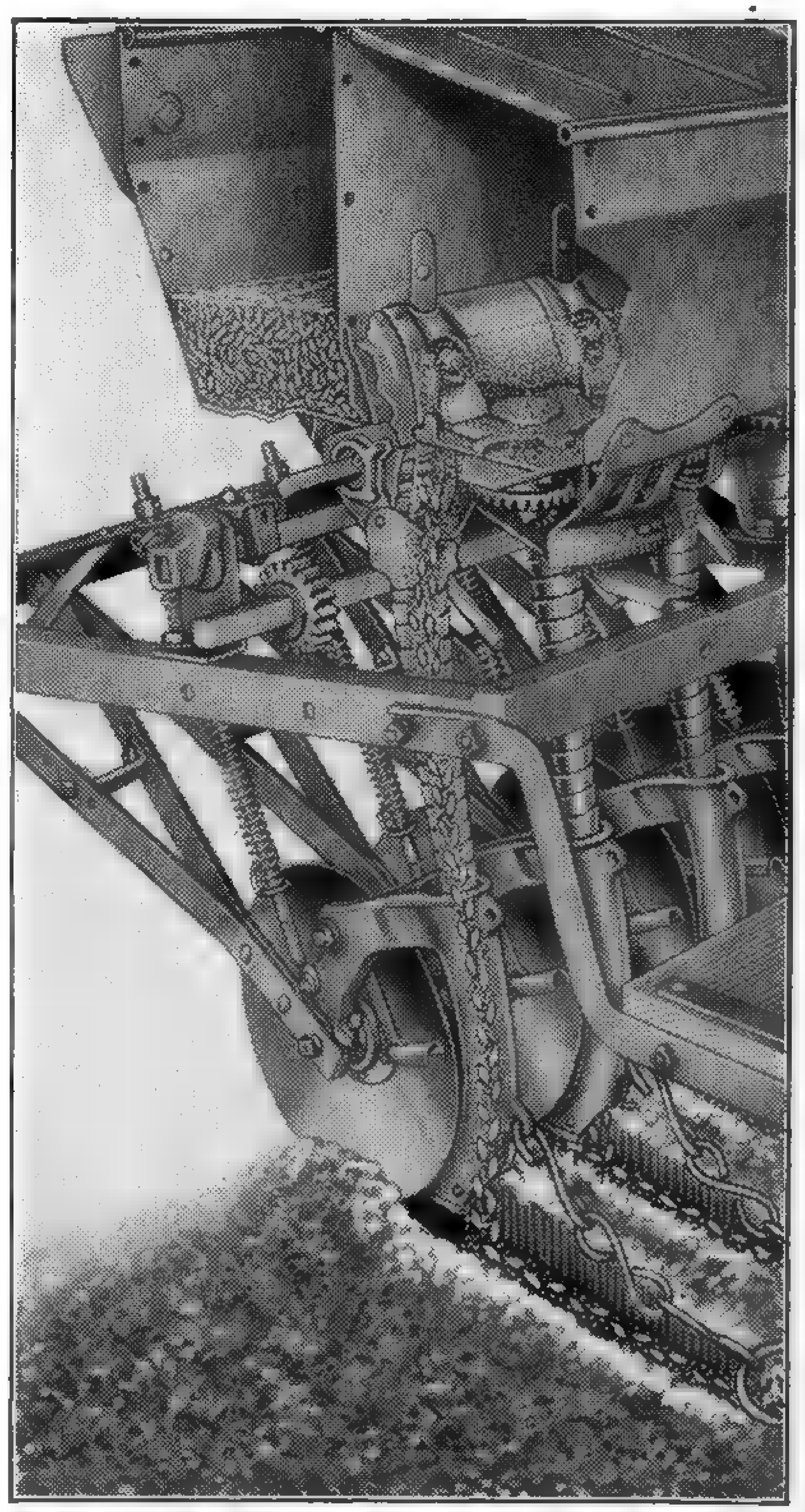


Figure 112—Here is what happens from the time seed and fertilizer leave the box until they are deposited in the seed trench and covered. The fertilizer, represented by the shaded area in the rear compartment of the box, flows down the spout and into the seed tube with the seed.

Because of the increasing use of highly concentrated fertilizer, a number of drill manufacturers are now offering a special fertilizer attachment for all types of drills which keeps the fertilizer from coming in contact with the seed. The fertilizer is released through separate tubes and deposited in the rows, but there is always a layer of soil between the fertilizer and the seed. The depth is controlled by a simple adjustment on the fertilizer boot.

Fluted Feed. The fluted force-feed consists mainly of a feed roll, feed cut-off, feed cup, and an adjustable gate.

The feed roll turns with the shaft, forcing the grain out over the feed gate which is adjustable for different sizes of seeds. The feed cut-off and the feed roll shift with the feed shaft, and their position determines the quantity of seed sown. The one-piece seed cups aid in maintaining accuracy because they do not become loose and get out of line. See Fig. 114 for detailed explanation.

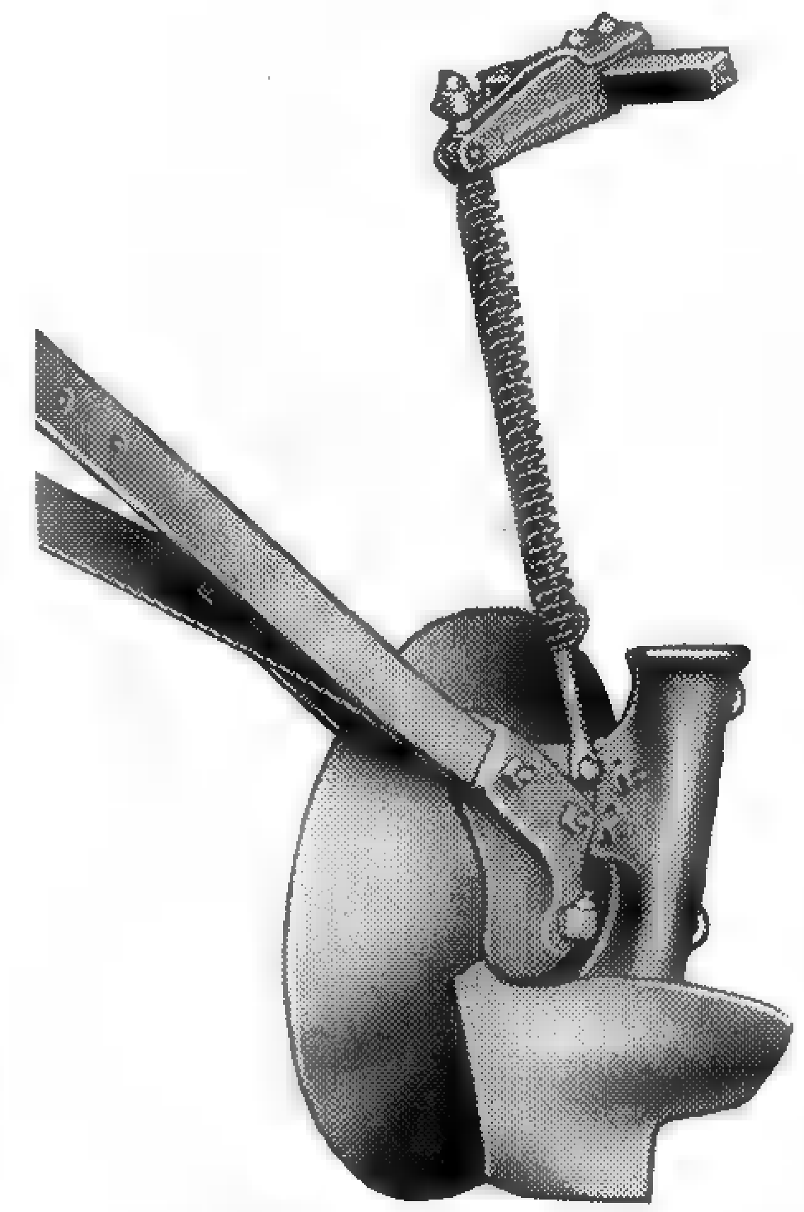
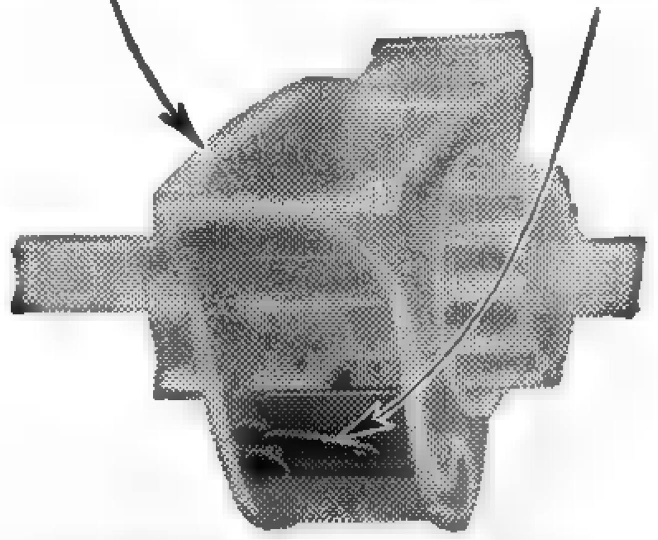


Figure 113—Furrow opener with moldboard as used on deep furrow drill.

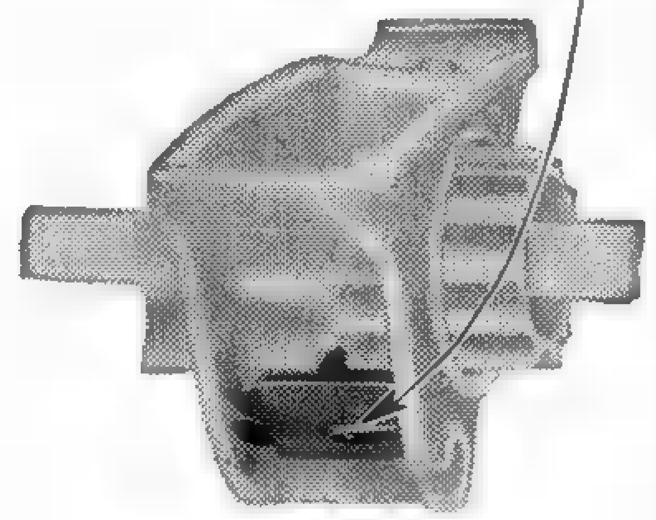
Setting Fluted-Feed Drills for Quantity. The first adjustment in using any drill is to set it to sow the desired quantity per acre. This is done on fluted-feed drills by adjusting the feed shaft and the gates on the feeds to suit the size of seed and the quantity to be sown.

The setting of the adjustable-gate force-feeds, according to size of seed, is described under the illustrations in Fig. 114. Before putting grain in the box, all gates should be let down as in No. 4, and all grain and accumulations cleaned out. To insure uniform planting, the latches on all feeds must be kept in same position while seeding.

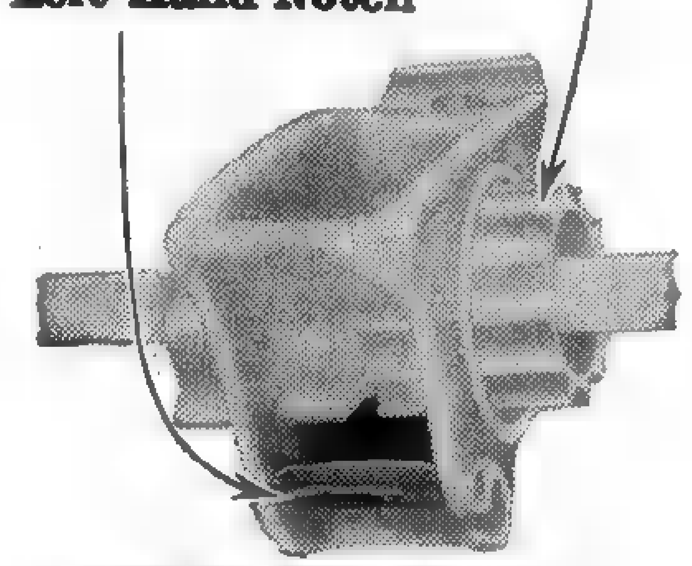
The feed adjustment, or feed shaft shifter, moves the feed rolls and feed cut-offs to permit more or less grain to be forced out by the feed rolls. There are two of these shifters on drills having more than eight disks, one for each half of the drill. Both must be kept in the same position on the seed index plate, which is provided with a row of notches to hold shifters in position. These notches are numbered by the figures which are immediately above them. Figures above at left of notches indicate the amount of flax and alfalfa—in pounds—to be seeded per acre. Figures below notches indicate amount of oats, barley, wheat, and peas—in pounds—to be seeded per acre.



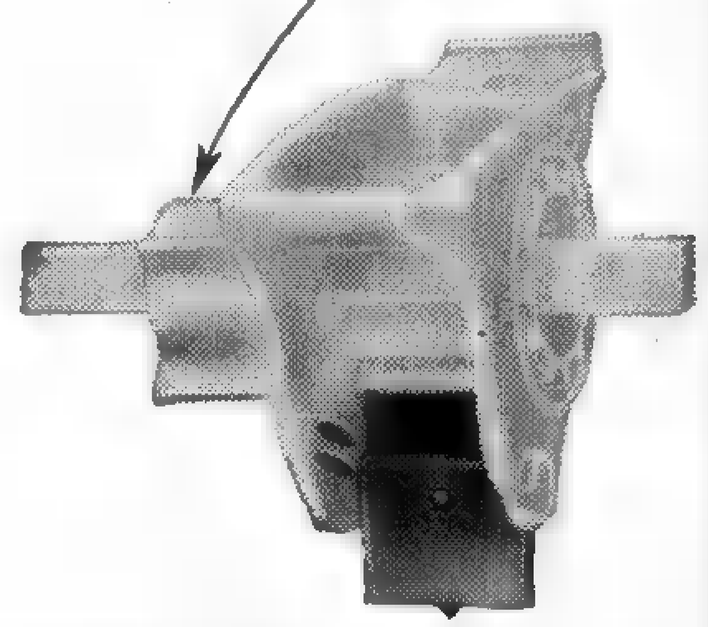
Position 1—All gates up with latches in top notch at left side to sow all grains, small seeds, [redacted] corn, and beets.



Position 2—Fasten all latches at right [redacted] to sow peas, common beans, soybeans, corn, and extra large quantities of trashy oats.



Position 3—Fasten all latches in lower notch on left side to [redacted] soybeans, [redacted] fat, [redacted] kidney beans.



Position 4—Drop gates to clean feeds.

Figure 114—Detail of the fluted feed showing different settings that can be made for planting seeds of various sizes. Quantity is controlled by shifting the feed roll and feed cut-off to permit more or less of the feed roll to turn within the feed cup. This is done with the feed shaft shifter.

Double-Run Feed Drills. The double-run feed drill gets its name from its type of feed, illustration of which is shown in Fig. 115. The feed and the mechanism which drives it constitute the principal differences between this type of drill and the fluted-feed drill shown in Fig. 111.

Fig. 115 shows two views of the double-run feed. It consists mainly of a feed wheel and a feed gate. The wheel is smaller on one side for use in planting small seeds. The large side is used for planting oats, barley, treated wheat, peas, beans, and other large seeds.

Lock lever on small side of feed, used for regulating inside quantity feed gate, and the positions at which it may be set. Numerals indicate the positions.

Showing adjustable gate inside the feed cup for regulating size of the feed opening to handle different quantities of seed.

Figure 115—Detail view of double-run feed, showing large and small sides.

The adjustable gates, which are inside the feed cups, regulate the size of the feed openings. Opening positions vary in number, providing a variety of different quantity adjustments to meet practically every seeding requirement.

Calibrating Grain Drills. The operator should be sure to have his drill set properly before starting to sow. If there is doubt in his mind as to the accuracy of his machine, he may make the calibration test which follows:

To check the accuracy of a grain drill, jack it up in working position, fill the box with grain, place a canvas in position to catch the grain, and set the gates and feed shifters properly. Find the total width of strip planted each time across the field. Divide 43,560—the number of square feet in an acre—by the width of strip planted and you have the length of a strip necessary to make one acre. Then find the number of times the drill wheel must turn in going this distance by dividing the number of feet by the circumference of the wheel.

Tie a cloth to a spoke of the wheel and count the revolutions as you turn the wheel, turning at about the same speed it would travel at work. You need not sow a whole acre—one-fourth of an acre is sufficient for the test.

When the correct number of revolutions has been made, weigh or measure the grain on the canvas and check it with the adjustment of the feed-shifter scale. If the drill is planting more or less than it should, the difference can be taken care of by adjusting the feed shifters.

Field Operation. To do a good job of sowing, the drill must be run steadily and evenly. Swinging of poles or unsteady driving causes bunching of seed and results in reduction of yields.

The depth of seeding over full width of the drill is controlled by the lifting levers and by a pressure spring on each furrow opener. When pressure is applied to the furrow openers, it should be uniform. Uniform pressure can be gained only by having both lifting levers in the same notch and having the pressure on all springs the same. The pressure on each furrow opener is adjusted by raising or lowering the adjusting collar on the pressure rod.

The tilting levers on rear of poles provide easy adjustment for proper relation between penetration and depth of planting when using any type of furrow opener.

Figure 116—Seeding with single-disk fertilizer drill.

Disk scrapers should be adjusted as lightly as practical and disengaged entirely, when possible, to prevent wear.

The land measurer is provided to measure the number of acres covered by the drill. On some drills, the land measurer is driven from the main axles; on others, from the feed

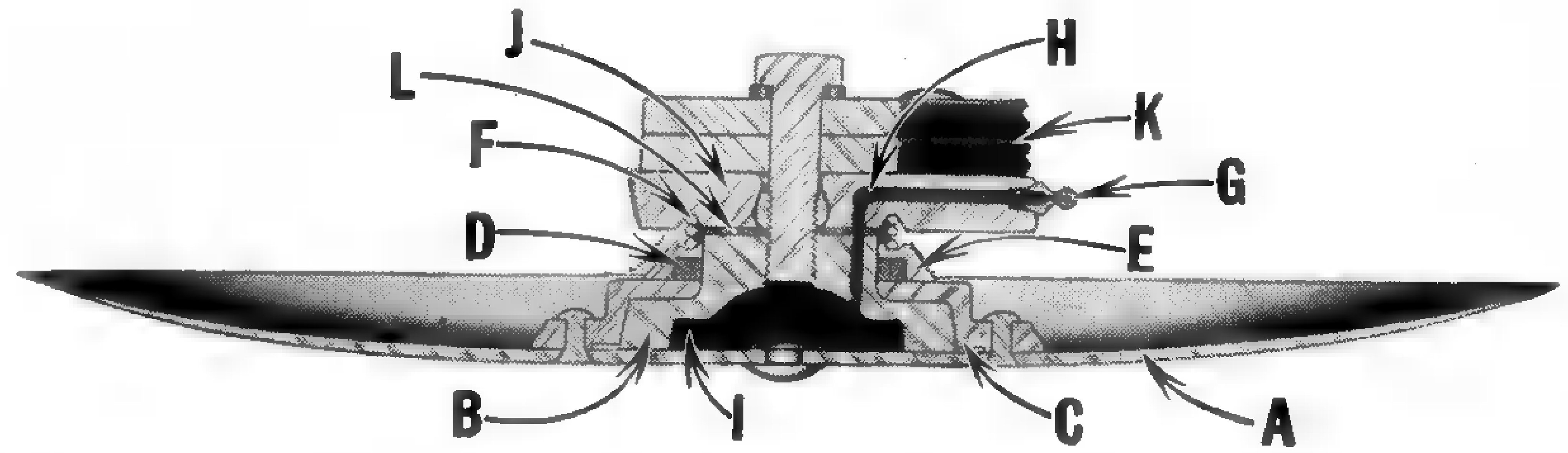


Figure 117—Cross-section of drill disk showing "A," disk blade; "B," disk bearing; "C," bearing case; "D," felt washer; "E," hard-iron dust cap; "F," dust cap spring; "G," Alemite fitting; "H," oil passage; "I," oil reservoir; "J," disk boot casting; "K," drawbar; "L," gasket.

shaft. To set it when starting a new field, press top of measurer in to force the bottom gear out of contact with worm gear on feed shaft or axle. Turn bottom gear to right—about 1/8 of an acre—to disengage fraction gear from acre gear. Move the indicator to largest number on acre dial and turn bottom gear to left, with indicator on fraction dial in upward position.

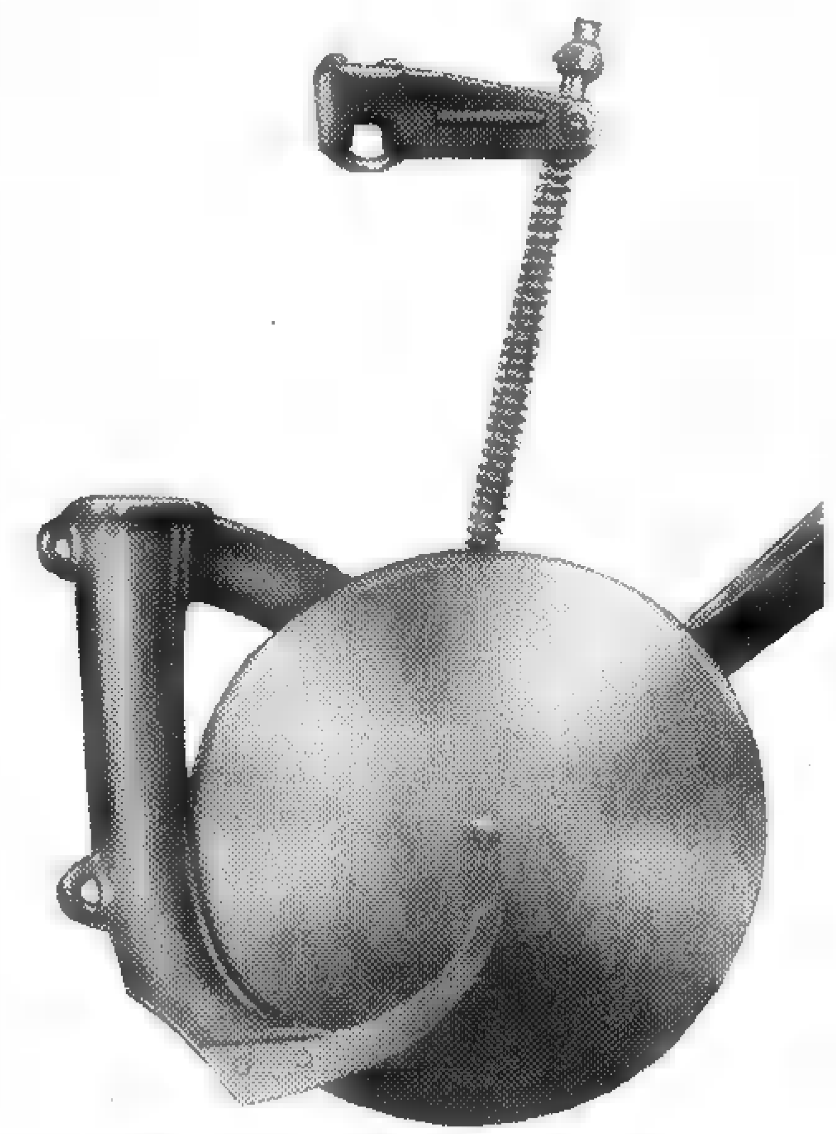


Figure 118—Single-disk opener.

Care of Drills. The drill should be cleaned and put in condition for the next season's seeding before it is stored. All seed should be cleaned out, the disks or other opener surfaces cleaned and oiled, and the machine put under shelter. Good treatment prolongs the life of the drill.

Most drills are equipped with fittings for pressure-gun lubrication. The disk bearings should be kept oiled thor-

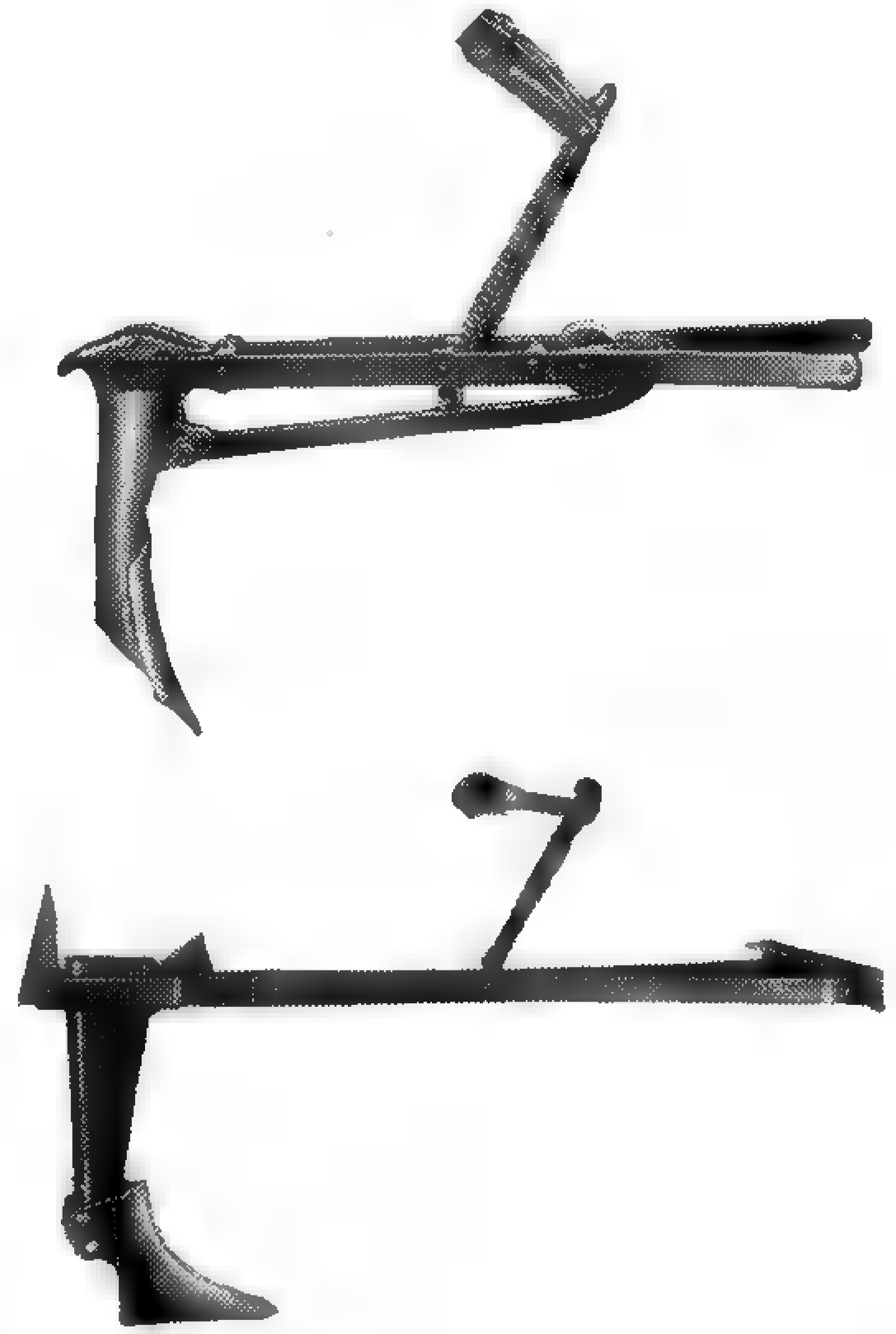


Figure 119—Hoe-type of furrow opener with spring-trip, above, and the lister-type opener, shown below.

oughly with oil or grease of proper viscosity as listed in the manufacturer's instruction book. Bear in mind that the disk bearings operate largely below the surface of the ground and, for that reason, it is highly important to keep the oil chamber well filled with oil of proper grade. See the cross-section of disk and bearing, Fig. 117. Double-disk openers are oiled from the top of the boot.

Types of Openers. Fig. 120 shows a cutaway view of a double-disk furrow opener, illustrating how seed is protected in seed tube and between disks until it reaches the bottom of the furrow.

Figure 120—Cutaway view of double-disk opener showing how seed is protected between [illegible] until it reaches the open furrow.

Fig. 119 illustrates the hoe-type opener which is especially adapted to seeding in rocky soils, and the lister-type opener. Boots have ample clearance for working in trashy conditions and are adjustable for various depth settings and degree of ridging.

Fig. 118 shows a single-disk opener with pressure spring, scraper, and disk boot.

The single-disk deep furrow opener is used with 12-, 14-, or 16-inch spac-

ing, to make wide, deep trenches and ridge the soil to catch the moisture and prevent soil from blowing. It is used most widely in winter-wheat sections.

The deep furrow opener with moldboard and seed deflector is shown in Fig. 113.

All types of furrow openers are interchangeable.

Questions

1. *What is the relation between planting and crop yields?*
2. *What is considered good planting of the crops grown in your community?*
3. *What are the advantages of a fertilizer drill?*
4. *Describe the double-run type of feed and its adjustment.*
5. *Describe the fluted feed and tell how you would adjust it for quantity.*
6. *How and why would you calibrate a grain drill?*
7. *How is depth of sowing controlled?*
8. *What are the important points to remember in caring for grain drills when in operation and between seasons?*
9. *What type of furrow opener is used in your community and why?*
10. *Is the lister-type drill used in your area? If so, what are its advantages?*

Chapter VI.
ROW-CROP PLANTERS

Accurate planting has more to do with yields of row-crops than any other single mechanical factor. If more seed is planted than the soil will support, the individual plants will not produce to fullest possibility; if less seed is planted than the soil will support, planting time and land are wasted—the farmer is not getting full return from his investment in time and capital. The importance of proper seeding takes on added significance as the practice of fertilizing at planting time increases the initial investment and prospect of yield.

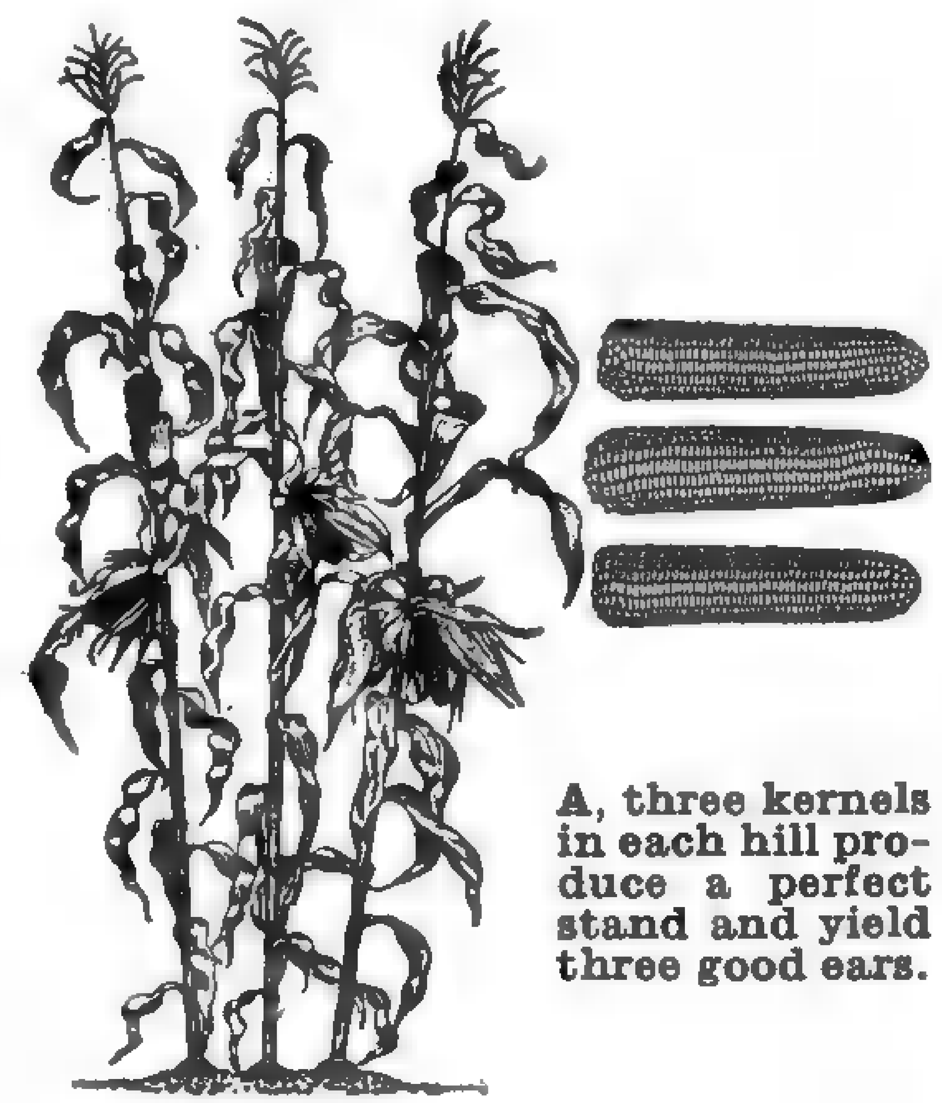
Corn Planters. Corn is grown in every state of the Nation. It is the principal crop throughout the corn belt and its importance in other areas of the country places corn planters first in our discussion.

While there is a definite trend to contour farming and, consequently, to drilled corn, the majority of corn in the corn belt is cross-checked. Here the mechanical accuracy

Figure 121—Planting at high speed on a corn belt farm.

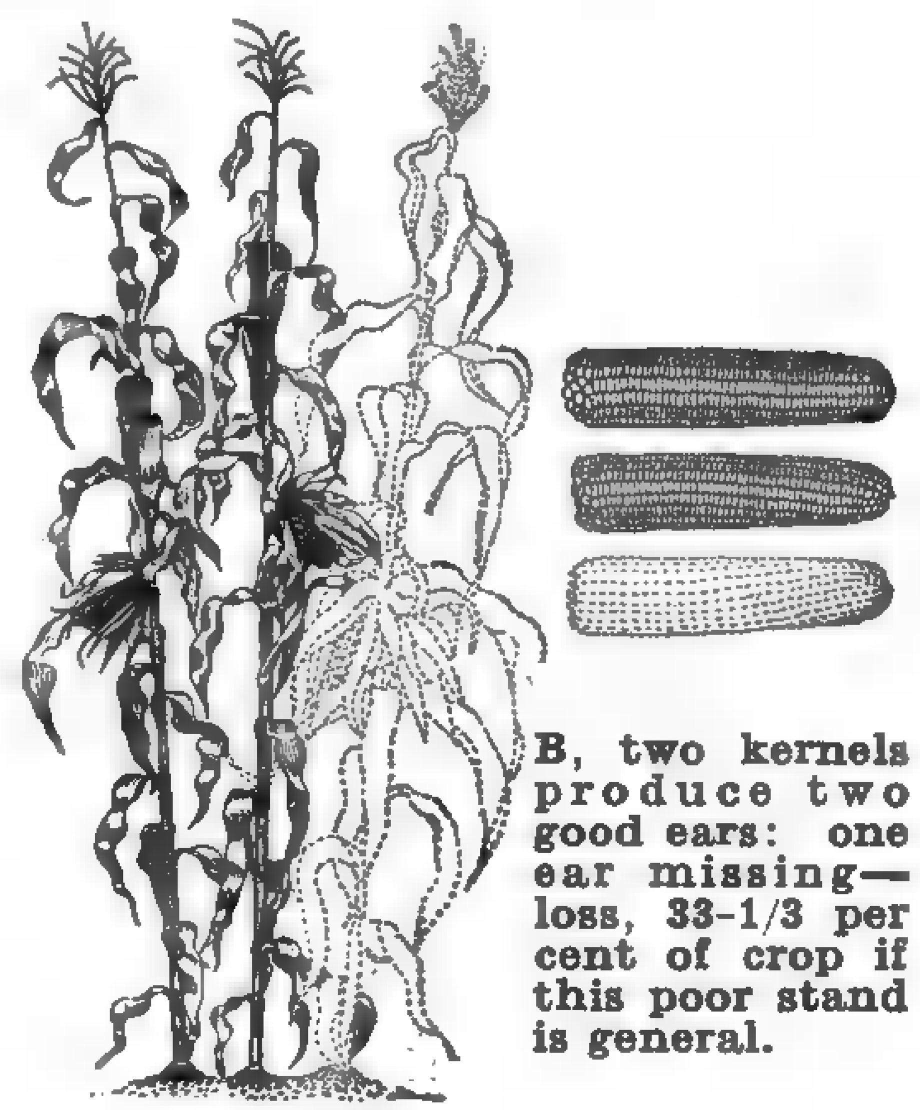
of the planter in dropping the right number of seeds for full yield must be combined with accurate spacing to insure the perfect cross-check for easiest cross-cultivation. If hills are crowded, barren stalks and small ears result. If hills are missed, or if less than the desired number of seed is dropped, time and land are wasted. If hills are "out-of-check," difficulty will be encountered at cultivating time.

The illustrations in Fig. 122 picture the results of accurate and inaccurate planting when three stalks per hill are ideal for soil conditions. In poor soils, two stalks per hill are sufficient, while in very rich loam soils four stalks will do well. The inaccurate spacing of drilled corn will result in the same losses as pictured in Fig. 122.



A, three kernels in each hill produce a perfect stand and yield three good ears.

Figure 122—Illustrations A, B, and C contrast the usual results of accurate and inaccurate planting when the soil will support three stalks of corn and produce three good ears in each hill.



B, two kernels produce two good ears: one ear missing—loss, 33-1/3 per cent of crop if this poor stand is general.

C, four kernels to the hill in soil that will support only three, usually results in one barren stalk, one nubbin and two medium ears.

Drop and Seed Plates. The accuracy of a corn planter depends upon the accuracy of the drop and the selection of seed plates best suited to the size of seed to be planted—taking for granted, of course, that seed is of uniform size and that dirt has not clogged the seed passages.

Figure 123—Top view of corn hopper bottom showing seed plate in position.

There are two types of corn crops—the accumulative and the full hill. The accumulative drop is generally conceded to be more accurate because it takes one seed to each cell in the seed plate and then counts out the number of seeds to a hill as desired. A full hill-drop planter takes all the seeds that make up the hill into one cell. It is claimed, and probably rightly so, that it is easier to get one seed in a cell each time than it is to get more than one, the same number each time. The accumulative drop is described in the following paragraphs.

Fig. 124 shows a cross-section of a seed hopper bottom with seed plate in position. Note that the hopper bottom is sloping so that the weight of the seed will cause it to move to the sides and enter the openings in seed plate. Fig. 123 shows top view of the hopper bottom.

The assembly of the hopper, seed plate, and bottom false plate is shown in Fig. 125. This also illustrates how seed plates are removed, without removing seed from the hopper, by tipping the hopper forward and releasing the spring latch that holds the bottom plate in place. Extra-wide

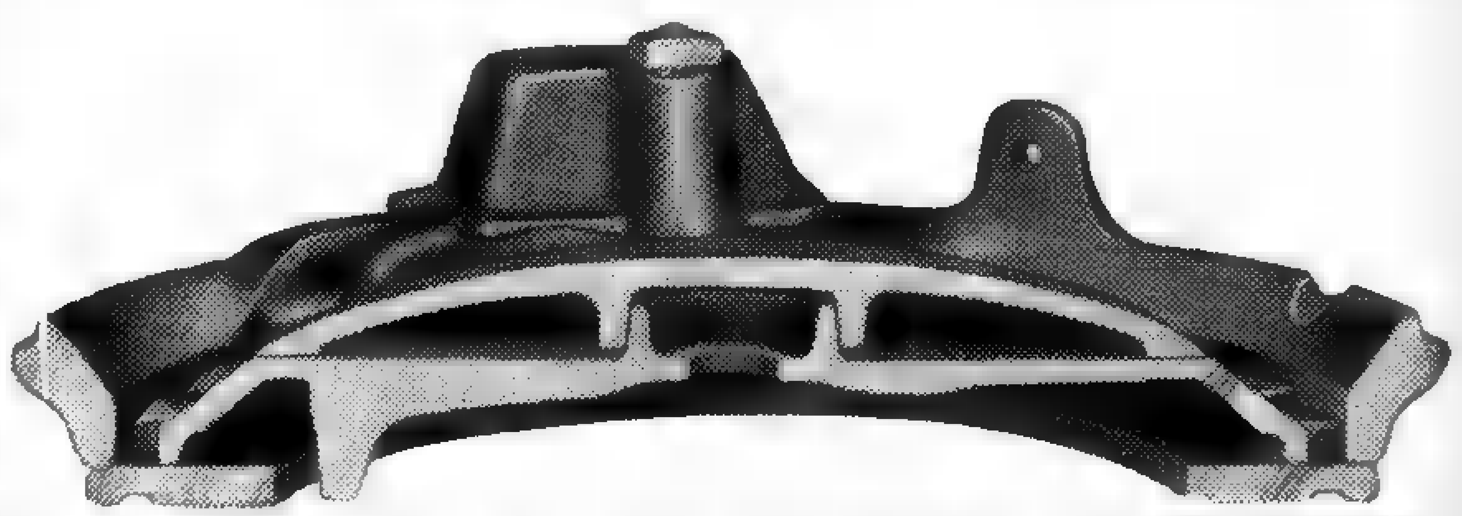


Figure 124—Seed plate and hopper bottom cut to show sloping hopper bottom, sloping hopper wall, and oblique seed plate.

seed is accommodated by reversing the false bottom plate as indicated in the drawing.

Seed plates are now available for seed of any size from kafir to lima beans, including a full range of plates for handling the various hybrid strains of corn. Fig. 126 illustrates the importance of selecting the right seed plates by fitting the seed to be planted in the seed cells as shown. If cells are too large, two kernels may pass into one cell, resulting in overcrowding the hill; if too small, less than the wanted number of kernels will be dropped.

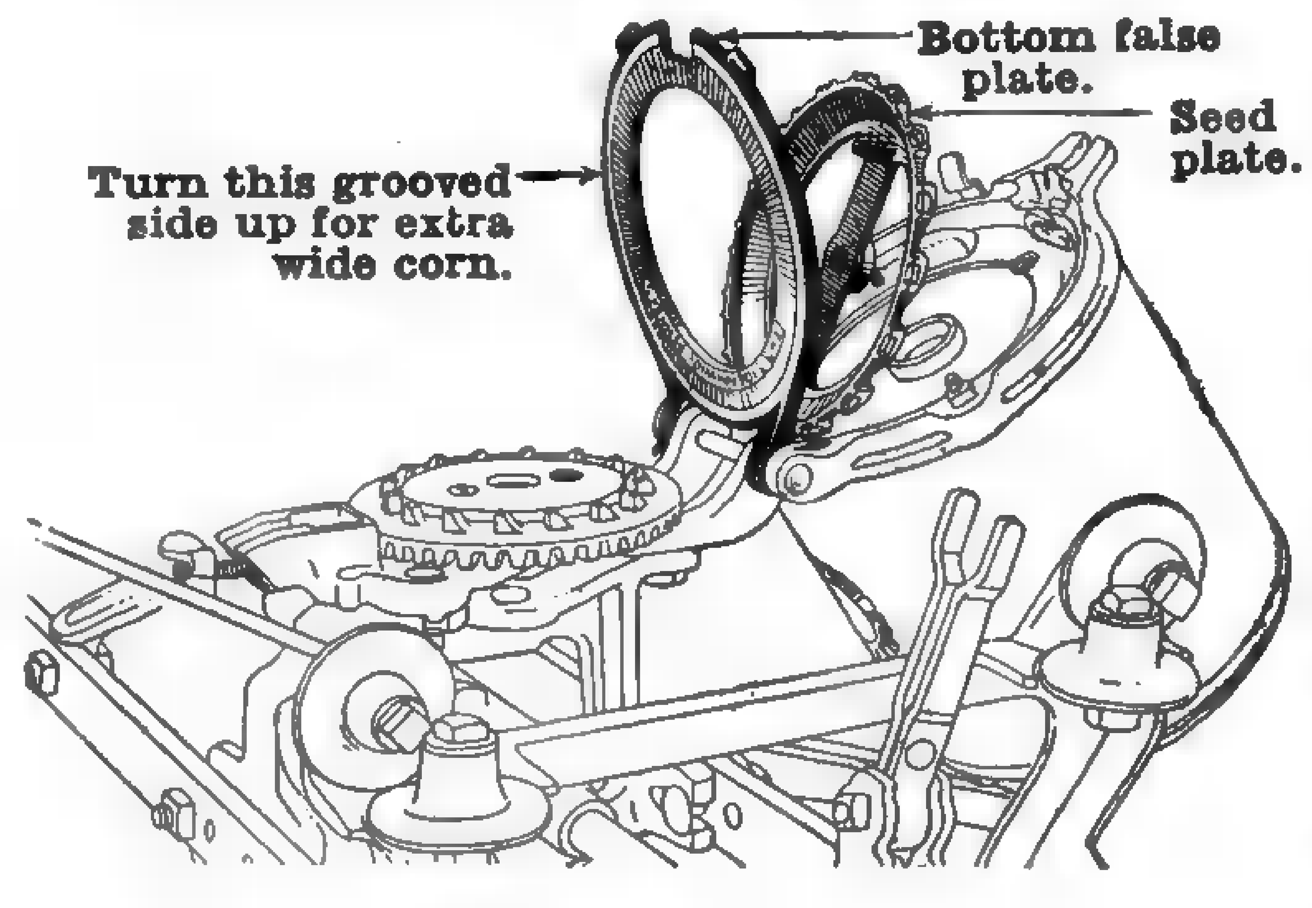


Figure 125—Assembly of the hopper, seed plate, and false plate showing how seed plates are removed by tipping hopper forward.

Checking or Drilling. Practically all corn planters can be used for both checking and drilling. The planters shown are easily adaptable for checking two, three, or four kernels per hill and for drilling seed in practically any spacing desired.

In drilling, seeds can be planted in any practical spacing desired. This wide range can be obtained by using plates having from two to twenty-four cells, setting the variable drop shifting lever on two, three, or four, or using the drive chain on the large, medium or small drive sprockets. A scale, showing how to set machine for any drilling distance, is provided with each planter. If

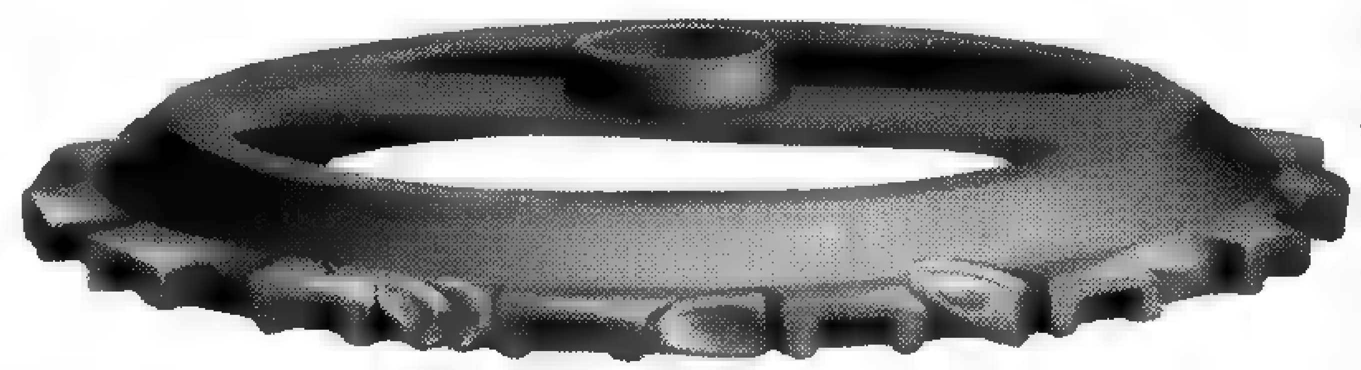


Figure 126—Illustrating how to select proper seed plates for an accumulative drop. Corn must fit the cells of the plate like the kernel marked "B." If kernels are too large as "C," or too small as "A," a plate having cells that will hold one kernel at a time should be selected.

this scale is not available, a few minutes spent in experimenting with various settings will give the desired adjustment. The plates used for checking usually can be used for drilling, the operator using the shifting lever and sprocket adjustments to get desired spacing.

The information on drop, seed plates, and spacing, given above, applies generally to all corn planters. Basic differences in construction in these two types of planters which require separate discussion will be considered in a following section on tractor planters.

Checking Accuracy of Drop and Cross-Check. To test accuracy of the crop on most tractor planters, simply raise the runners high enough so that they skim the ground. Proceed to "plant" about 100 feet. The planter unit will drop the seed on top of the ground, permitting you to check accurately the distance between hills, the number of kernels being dropped in each hill, and the grouping of the seed in the hill.

To test for good cross-check, carefully dig up a row of at least eight hills crosswise to the direction of travel, and set a stake in center of each hill. (Due to the travel of wire, the hill of corn should be found about an inch behind the button.) An adjustment is provided on the planter which permits tilting front of planter to place hills closer to, or farther from, button. Tilting front by lowering runner tips places hills farther back, while raising runner tips places hills forward.

Most planters can be spaced for a variety of row settings. To adjust width of planter, remove bolts that hold shanks to frame, remove bolt holding drive pinion on drive shaft, and adjust the shanks in or out to width of row desired. Be careful not to slip pinion off the shaft as the timing will be disturbed. Adjust wheels in line with the runners.

Field Operation. The object of check-rowing corn is to make cross cultivation possible. Cultivating crosswise of the rows is a difficult task if checking is not straight, and the straightness of crossrows depends more than anything

else upon the handling of the check-wire.

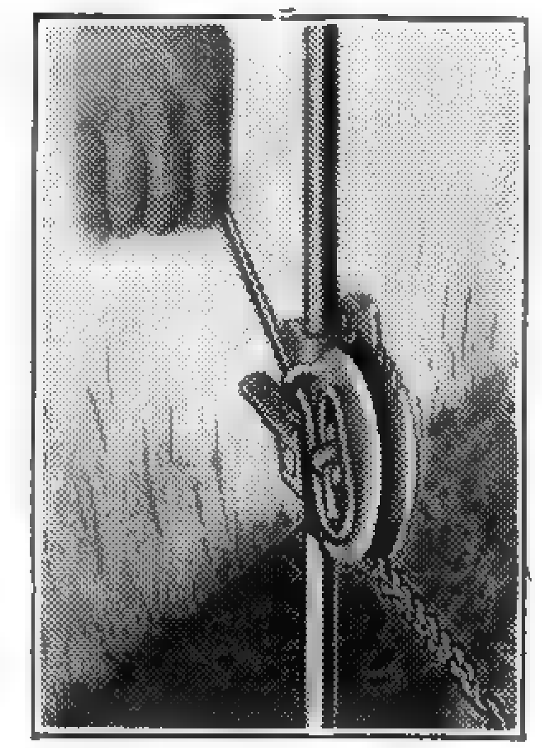


Figure 127—Built-in tension meter.

The check-wire should be stretched reasonably tight and kept at that tension. Uniform checking depends upon maintaining that tension each time the stakes are re-set. Some planters have anchor stakes with built-in tension meters which make it easy to pull the check-wire to the same tension each time the stake is set.

Crooked crossrows may also be caused by running front of the planter at an improper level, in which case every pair of rows will be out of check. This may be adjusted as explained in a preceding paragraph.

If only one side is out of check, it may be caused by incorrect adjustment of valves, frame of planter being bent, or by a weak rocker-shaft spring. A bent frame may also cause one row to be planted deeper than the other.

If the planter scatters seed between hills, the trouble may be due to kinks in the check-wire, an obstruction in the valves, or too little tension on the rocker-shaft spring.

Tractor-Drawn Planters. With the advent of the row-crop tractor, farming operations generally stepped up in speed. This was true in practically all farming operations with exception of planting, which was restricted to horse speed because the type of valve in common use would not drop the seed quickly enough to prevent "strung-out" hills. Careful study of valve design proved definitely the reason why valves which were accurate to a high degree at slow speed became undependable at faster travel.

As the seed is released from the upper valve, it drops to the lower valve with sufficient momentum to cause it to rebound. (See Fig. 128.) At slow speed there is ample time between buttons to permit seed to settle in the valve before the valve opens. However, when this same valve is called upon to release 125 hills per minute in place of the 88 hills

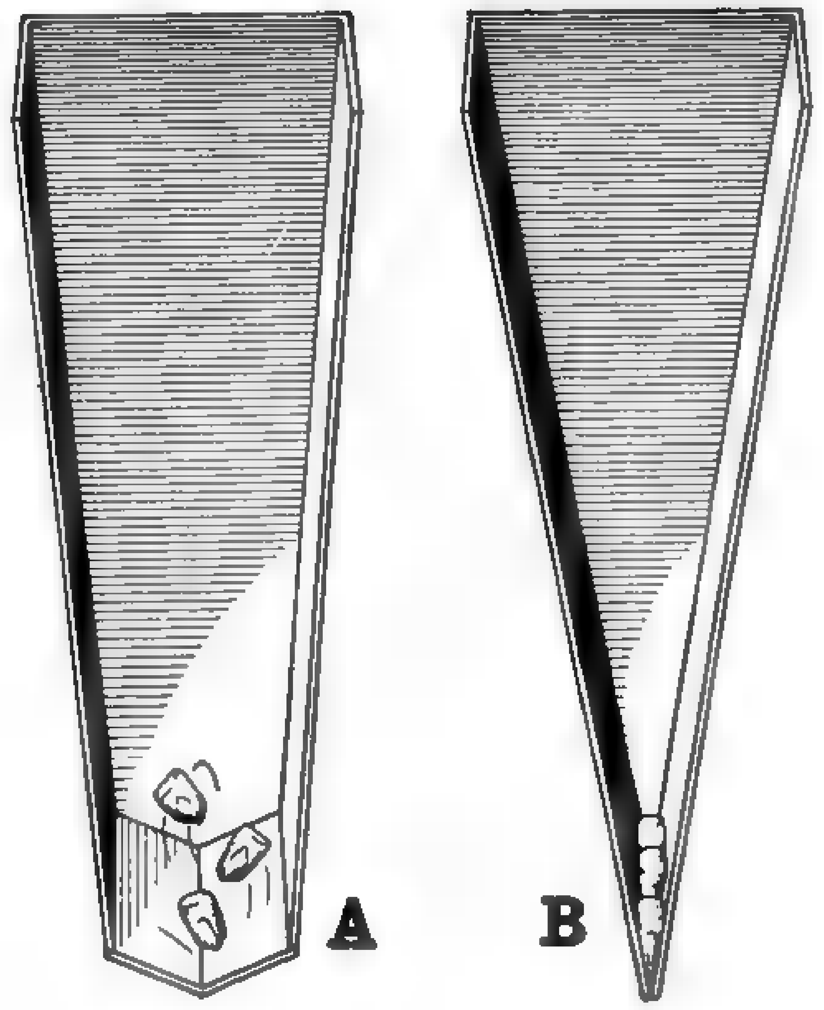


Figure 128—These two sketches show the principle involved in the horse-drawn planter valve and in the high-speed valve used in tractor planter.

In "A," note that kernels falling to lower valve, bounce for a moment. In the high-speed valve, "B," seeds are wedged in the bottom of the valve to be released in a group. See further discussion on this page.

per minute for which it was designed, the hills were strung out and, in some cases, kernels were trapped in the valve. Now, consider what happens when kernels are dropped from upper to lower valve in the high speed planter. Dropping down the tapered tube the seeds are wedged as they fall—they have no opportunity for a "split-second" bounce that results in loss of accuracy.

The tractor-drawn planters, shown in Figs. 129 and 130, are designed especially to plant accurately at the higher speeds of modern tractors.

The pressure wheel, set be-

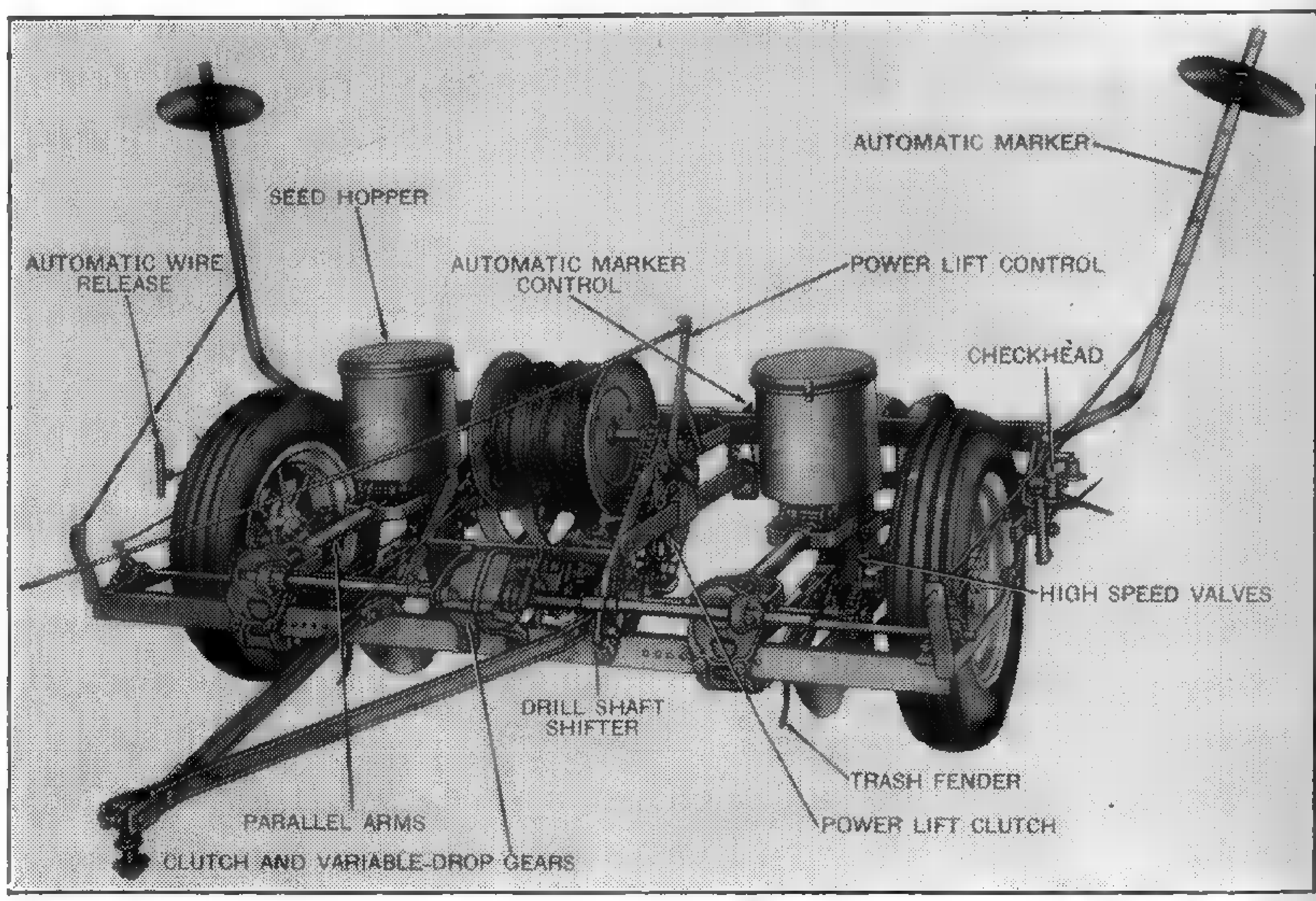


Figure 129—Two-row tractor planter designed for accurate planting at high speed.

hind each runner, acts as an independent gauge wheel for each unit. As a result, each planting unit works independently of the others, thereby permitting each runner to

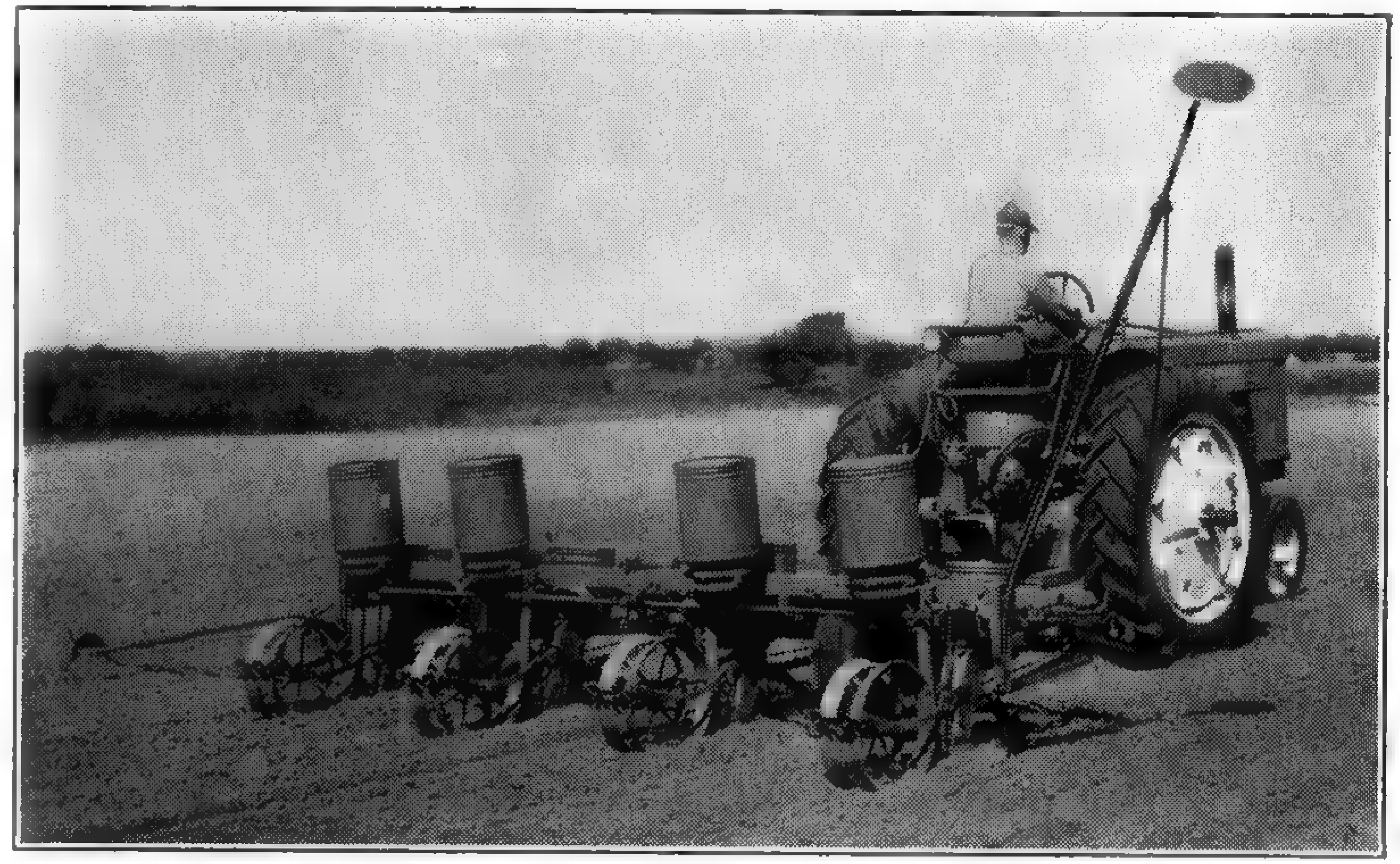


Figure 130—Four-row tractor planter checking [illegible] on a Midwest farm.

ride over ridges or down into depressions without causing variation in planting depth of any of the other units. A power lift clutch on the planter (similar to that used on tractor plows) raises the planter runners and the disk marker at the same time.

Equipment and Attachments. Several combinations of disk and runner furrow openers can be obtained to suit different soil conditions. Gauge wheels or gauge shoes also can be obtained.

In many sections of the country, fertilizer is sown when the corn is planted. A fertilizer attachment for this purpose is provided by most manufacturers.

It is important that the fertilizer be kept from coming in direct contact with the seed, for if this occurs, the seed is "fired." The fertilizer attachment places a strip of fertilizer

on each side of the hill after the seed has been partly covered with soil, so the fertilizer does not come in contact with the seed. Covering knives then throw soil over the fertilizer.

If it is desired to plant peas or beans along with the corn, the pea planting attachment may be added to the planter. Both the fertilizer and pea planting attachments can be used when planting corn, making it possible to plant two crops and sow fertilizer in one operation.

Combination Cotton and Corn Planters. The cotton grower requires a planter that will plant cotton, corn, and other row crops with equal accuracy. His multi-purpose planter must be quickly and easily convertible from one type of planter to another.

Most popular equipment of this type is the planting and fertilizing equipment which is used in conjunction with the

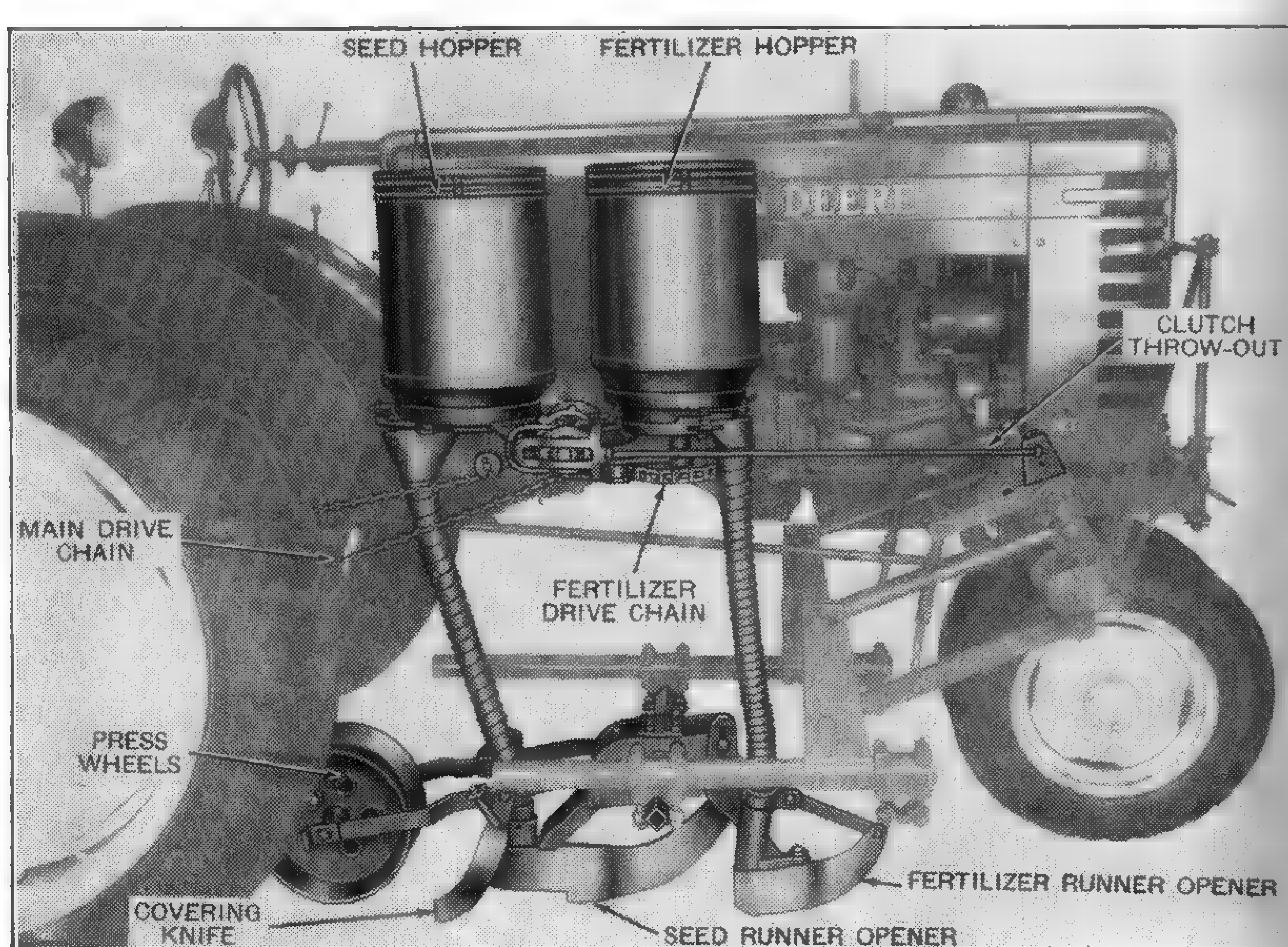


Figure 131—Detail illustration of planting and fertilizing equipment attached to the tractor cultivator. This equipment is available in various types to meet territorial requirements.

tractor cultivator. It offers several important advantages. Mounted on the cultivator frame, it makes use of the cultivator parts as framework for the planting and fertilizing equipment. At cultivating time, the planting and fertilizing equipment is removed, shovels placed in position, and the unit becomes a tractor cultivator. At planting time, the cultivating parts are removed and planting and fertilizing equipment is replaced. While the unit of this type shown in Fig. 131 is equipped with runner-type furrow openers and knife coverers, different furrow openers and coverers are available for planting requirements in practically all cotton and corn territories.

Planting Devices. Like corn planters, the success of combination cotton and corn planters depends upon the accuracy of the drop and its proper adjustment. The dropping device for all combination cotton and corn planters shown is the same.

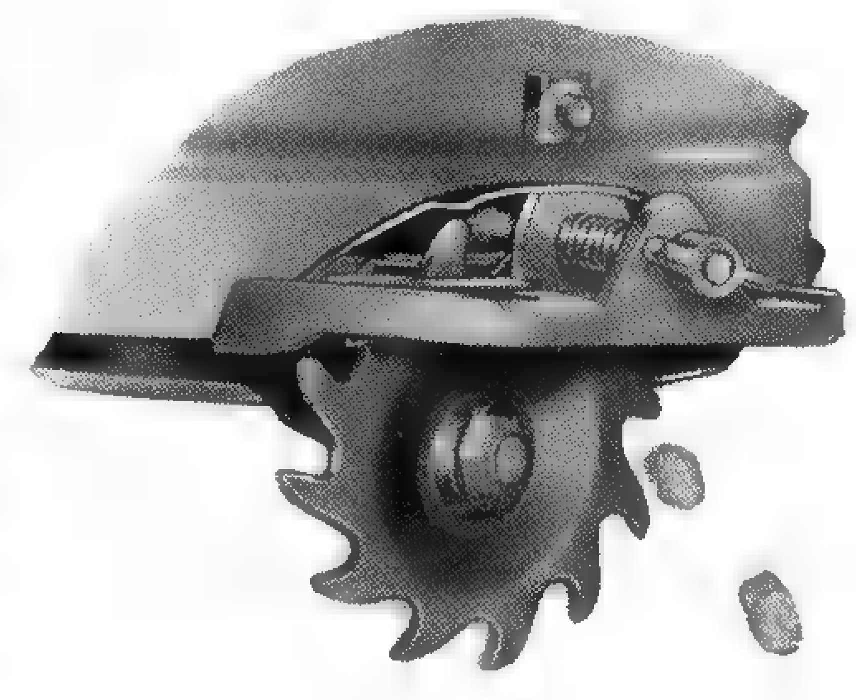


Figure 132—Cotton picker wheel showing how wheel picks out cotton seed one at a time. Quantity planted per acre is controlled by a turning thumb nut.

The corn drop is the same as that shown in Fig. 124 for the corn planter. Distance of drilling is regulated by the number of cells in the seed plate and by the various sprockets. The selection of seed plates that suit the size of seed to be planted is one of the most important factors in getting an even stand of corn. Fig. 126 illustrates this point.

Cotton seed is one of the most difficult of all seeds to plant accurately. For that and other reasons, it is usually planted thicker than required and the weaker plants chopped out. However, the grower wants as great a degree of accuracy as possible, and he needs to know how to adjust his planter to get best results. In unusually weedy conditions, many farmers prefer to check their cotton to permit cross-cultiva-

tion. Certain check-row planters give very good results even with undelinted cotton seed. Checking or hill-dropping cotton saves seed and reduces chopping.

The saw-tooth-type steel cotton picker wheel, shown in Fig. 132, picks out the cotton seed, one or more at a time, taking lint and trash from the hopper with the seed, and plants any quantity per acre desired. Fig. 135 shows a cross-sectional view of the hopper bottom with the cotton plate or spider in position. The spider revolves in an opposite direction to the picker wheel and delivers the seed in position for the teeth of the wheel to pick it out.

The cotton feed gate controls the amount of seed to be planted. Turning the thumb nut (see Fig. 132) to right or left increases or decreases the number of seeds picked out by the picker wheel.

The uncertainty of weather favorable to germination and growth of seed has always been one of the cotton grower's greatest concerns at planting time. If dry weather follows

Figure 133—Planting with planting equipment mounted on the tractor cultivator.

shallow planting, seed does not germinate; if wet weather follows deep planting, seed is apt to rot in the ground. Under either of these conditions, replanting, necessitating a duplication of time and labor expenditure, is necessary.

The advent of a variable depth attachment for cotton planters (Fig. 134) has made possible the planting of cotton seed at depths varying uniformly from surface planting to approximately two inches. The complete cycle of depth variations is repeated every thirteen inches. This method of planting eliminates much of the uncertainty for, regardless of the weather, some seed is planted at proper depth for good germination and healthy growth. Since the cycle of variation is repeated at regular intervals, the healthiest plants are always spaced uniformly.

Changing Plates. To change from cotton to corn planting, remove thumb nut that holds the cotton spider, remove the spider, and insert the corn plate and cut-off. No other adjustment is needed. Reverse the procedure when changing from corn to cotton.

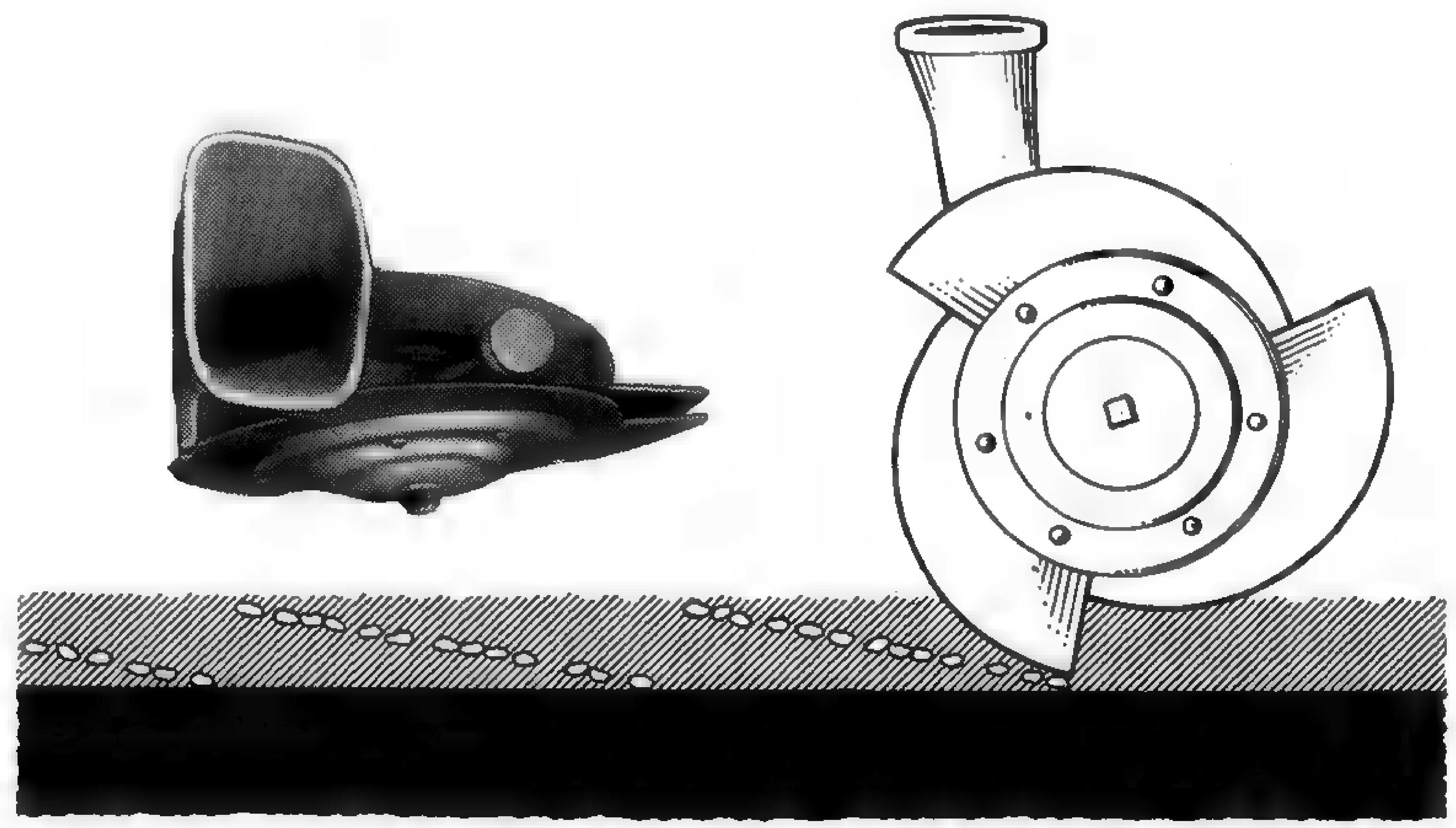


Figure 134—Schematic drawing showing seed placement when the variable depth attachment is used in planting cotton. Overhead view, at left above, shows the two disks which revolve in unison to open a furrow of varying depth.

Practically all types of combination cotton and corn planters can be used for planting other row-crops such as peanuts, kafir corn, etc., by using the proper-sized plates. Several types of planters are also adapted to sowing fertilizer at the time seed is planted.

Caring for Planters. To insure good work and accurate planting, planters must be well oiled and all parts must be firmly in position. Parts must be replaced when badly worn or the efficiency of the planter will be impaired.

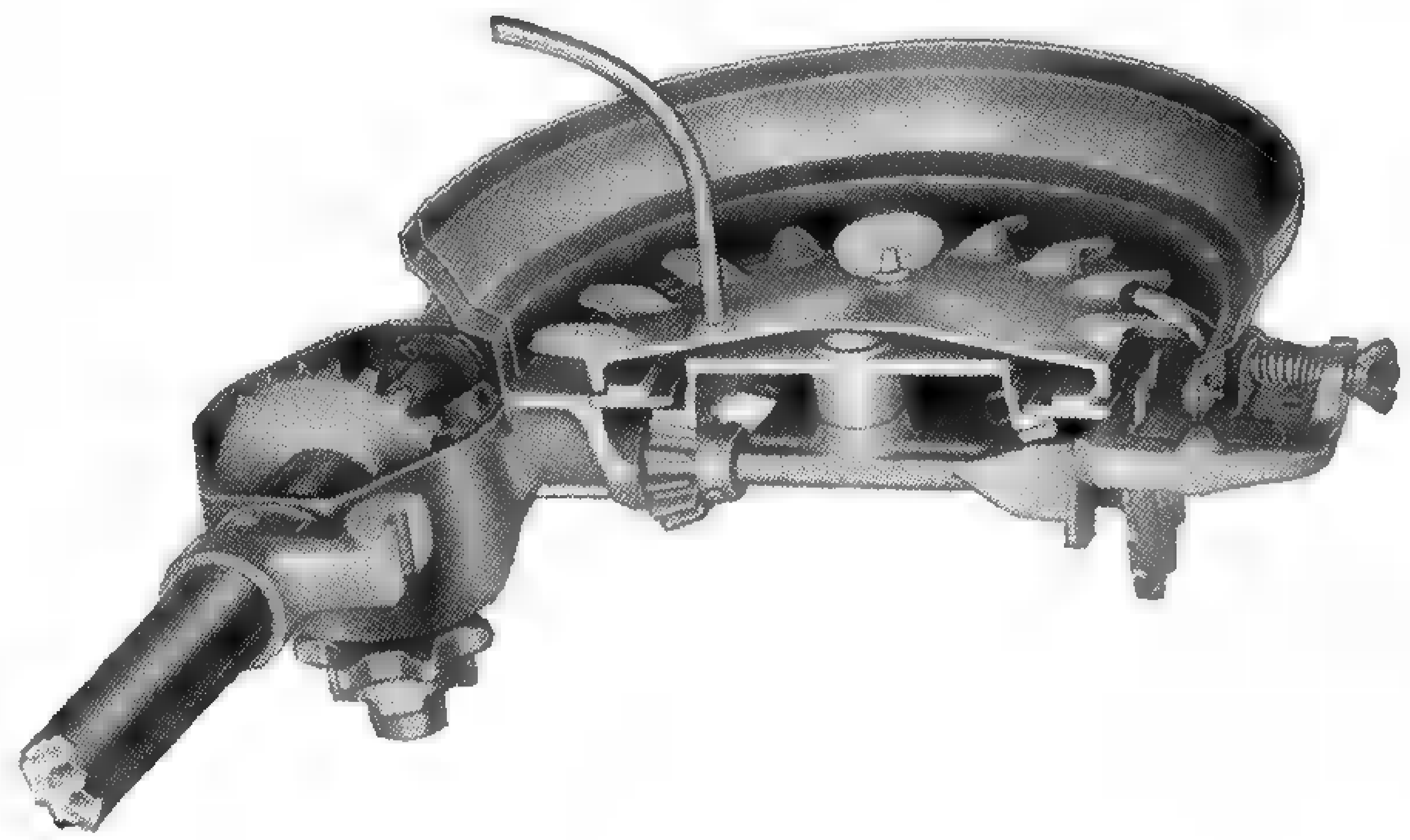


Figure 135—Cross-section of hopper bottom showing cotton plate and picker wheel in position.

Oil holes in a new planter should be filled with kerosene to cut out the paint, after which a good grade of machine oil should be used liberally on all friction parts with the exception of parts which are enclosed in housings and operate in a constant bath of oil inside the gear case. The gear case or housing in which these parts are enclosed should be filled to the level of the oil plug with clean, new oil of viscosity recommended by the manufacturer of your planter. Inspect the oil level occasionally and, if low, add sufficient new oil to fill gear case to proper level. Before the planting season opens, remove drain plug from bottom of gear case, drain old oil, and flush out with kerosene. Refill housing to proper level with clean oil. Frequent oiling adds to the life of a planter except in extremely dusty conditions when it is better to use only

kerosene on all working parts, excepting, of course, parts enclosed in housing.

The entire planter should be inspected carefully for broken or badly-worn parts which should be replaced before the planter is put into use. Since proper adjustment is so important to proper operation it is especially wise to check all parts for alignment and to be sure all nuts are drawn tight.

When planting in wet or sticky soils, the operator should keep close watch to see that the seed boots do not become clogged with dirt which will stop the seed from reaching bottom of the furrow. It is a good plan to inspect the boots and the entire dropping mechanism at regular intervals to see that parts are working properly.

Questions

1. *What results when row crops are planted too thick? Too thin?*
2. *What is considered the proper number of kernels of corn to plant in a hill in your community? If corn is drilled, what distance is considered best?*
3. *Name and describe the action of the two types of corn drops.*
4. *Describe the high-speed planter valve.*
5. *What test would you make in determining the size of seed plate to use?*
6. *What special equipment or attachments are used on corn planters in your community?*
7. *Why is cotton seed difficult to plant and how does the steel saw-tooth picker wheel overcome this difficulty?*
8. *How is the quantity of seed sown regulated?*
9. *What are the advantages of planting and fertilizing equipment for cultivators?*
10. *What are the important points to remember in caring for a corn planter?*

Chapter VII.

LISTERS

Listing is a method of raising corn or other row-crops in regions having limited rainfall. Its advantages under these conditions are many. Planting the crops in the bottom of the furrow, then filling in the furrow by cultivating, keeps the plant roots deep below the surface where moisture is more plentiful. The preparation of the ground, previous to listing, is not expensive. Listed crops can be easily cultivated and kept free from weeds. For this reason, a farmer can care for a larger acreage of listed than of surface-planted row crops.

Single listing consists of planting the crop when the ground is listed for the first time.

Blank listing is listing the seedbed without planting, an operation in which the listing plow is used, leaving the planting to be done with a regular corn planter or with the lister when double listing.

Double listing is the practice of blank listing in the fall to

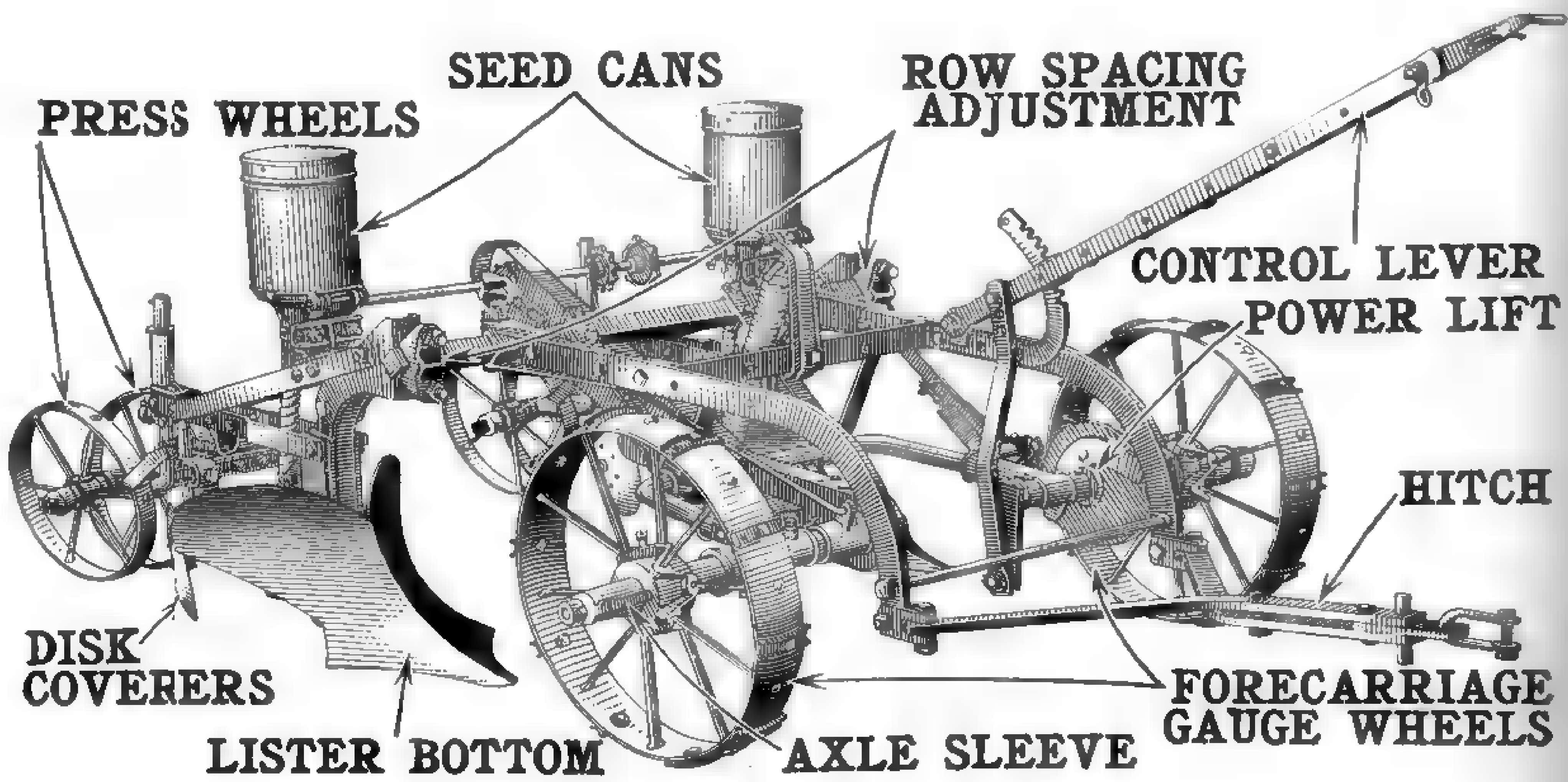


Figure 136—Two-row tractor-drawn lister with important parts named.

catch snow and hold the moisture, and splitting out the ridges and single listing in the spring.

Types of Listers. Because of the fact that the lister combines the duties of the plow and the planter, its selection as to type is important. Consideration should be given to style of bottom and coverers and to the size most practical for the acreage to be worked.

The two-row lister, shown in Fig. 136, is a modern-type, tractor-drawn, two-row size which will be discussed in detail in a later paragraph.

The semi-integral lister, illustrated in Fig. 137, is favored by owners of general-purpose tractors since it makes up a compact outfit with the tractor. The hydraulic power control of the tractor, raises and lowers the lister.

Bottoms and Planting Equipment. The planting efficiency of a lister depends upon its bottoms and seed-dropping devices. The bottom, the subsoiler, and the coverers are responsible for the entire job of preparing the seedbed and covering the seed. The dropping devices determine the

Figure 137—The semi-integral lister and general-purpose tractor make up a compact plowing and planting outfit.

accuracy of planting and the spacing of the seed. When these two units are in proper adjustment, the operator can expect to do a good job of listing.

The duties of the lister bottom are similar to those of the plow bottom. It opens the seedbed, turning a furrow each way and pulverizing the soil in the same manner as does the plow. The quality of its work is even more important than in the case of the plow, as it is usually the only equipment used to prepare the soil for planting.

To do a good job, the lister bottom must be of proper shape, its share must be sharp and properly set, and its surface well polished for good scouring. When the share is sharpened, it is important that the wings be set alike. If not set the same, one side will cut deeper than the other and cause the lister to run to one side and pull heavier. To obtain proper penetration in all conditions, the share point should have approximately the same amount of underpoint suction as a plowshare.

The planting mechanism used on the listers illustrated is the same as used on the corn planters and combination cotton and corn planters described in preceding chapters. The corn drop is the same as that shown in Fig. 124. The saw-tooth steel picker wheel, illustrated in Fig. 132, is used for cotton planting. Special plates for planting any row-crop can be obtained.

Figure 138—Blank listing with a two-bottom integral lister.

The importance of selecting seed plates with cells of proper size to suit the seed to be planted cannot be overemphasized. See Fig. 126, which shows how to select plate with proper-sized cells.

The seed plate and drive sprockets control the planting distance when planting crops other than cotton. The distance at which seed is planted varies with the number of cells in the seed plate used and the size of sprocket. The lister operator can select plates and sprockets to space the seed the desired distance in the drilled rows.

Field Adjustments. The tractor-drawn lister, shown in Fig. 136, is a typical two-row lister in general use. It is fully adaptable to listing requirements and is easily adjustable for row spacing desired. Both listing units are mounted by clamps to a common frame bar along which they are easily shifted to proper spacing. Front wheels serve the double purpose of forecarriage to support the front of the lister and gauge wheels to maintain uniform depth of tilling and planting. A single long lever serves as master lever to vary the depth of plowing and planting. The power lift unit in the left-hand wheel raises the lister. Press wheels at the rear firm the soil in the trench over the seed. Principal parts of the lister are indicated in the illustration.

On the two- and three-row listers, rows can be spaced at various distances apart by moving the hitch, bottoms, cans, and wheels in or out by means of the adjustments provided. The operator must be sure to move each the same distance so that all will be in line to plant rows of uniform width.

The subsoiler opens the seed trench. It should not be set deeper than necessary to do proper work—about one and one-half inches below the point of the share.

When rolling coulter is used, it must be set in line with the exact center of the bottom, or one furrow will be wider than the other, resulting in uneven work and side draft.

Covering disks or shovels must be set alike, or they will lead the lister to one side.

Rear wheels must run straight. The lock casting on the upright angle below frame casting must be kept straight so that wheels run parallel to each other. Wheels may be staggered in or out to meet soil conditions by reversing the axle.

Care of Listers. Length of service and working qualities of a lister depend greatly upon the care given it. All polished parts—bottoms, subsoilers, root cutters, and coverers—should be coated with oil whenever the lister is not in use. Rust pits on these parts prevent scouring and hinder good work. Disk coverers, wheel boxings, and all points of friction should be oiled regularly.

General overhauling after each planting season, with special attention to worn and loose parts, will add to the life of the lister.

Questions

1. *What is the purpose and what are the advantages of listing crops?*
2. *What is single listing? Blank listing? Double listing?*
3. *Describe several types of listers.*
4. *Why are the bottoms of first importance to good work in a lister?*
5. *How is planting distance controlled?*
6. *How is row spacing controlled on two- and three-row listers?*
7. *What is the purpose of the master lever? Leveling lever?*
8. *What are the important points in caring for a lister?*

Chapter VIII.

POTATO PLANTERS

Growing potatoes for market without modern equipment for planting and harvesting them is an expensive and laborious task. The slow, difficult hand-drop method of planting has been supplanted by mechanical planters that open a furrow, space the seed at the desired distance, and cover it at the proper depth. Mechanical diggers that remove and separate the potatoes from the soil and vines do away with the slow, tiresome practice of plowing out the crop with an ordinary plow.

The potato planter is in quite common use in most sections of the country even where comparatively small acreages are planted. It has been an important factor in making potatoes a profitable crop—one that ranks high in value among the leading crops. Lower production costs, due to saving time

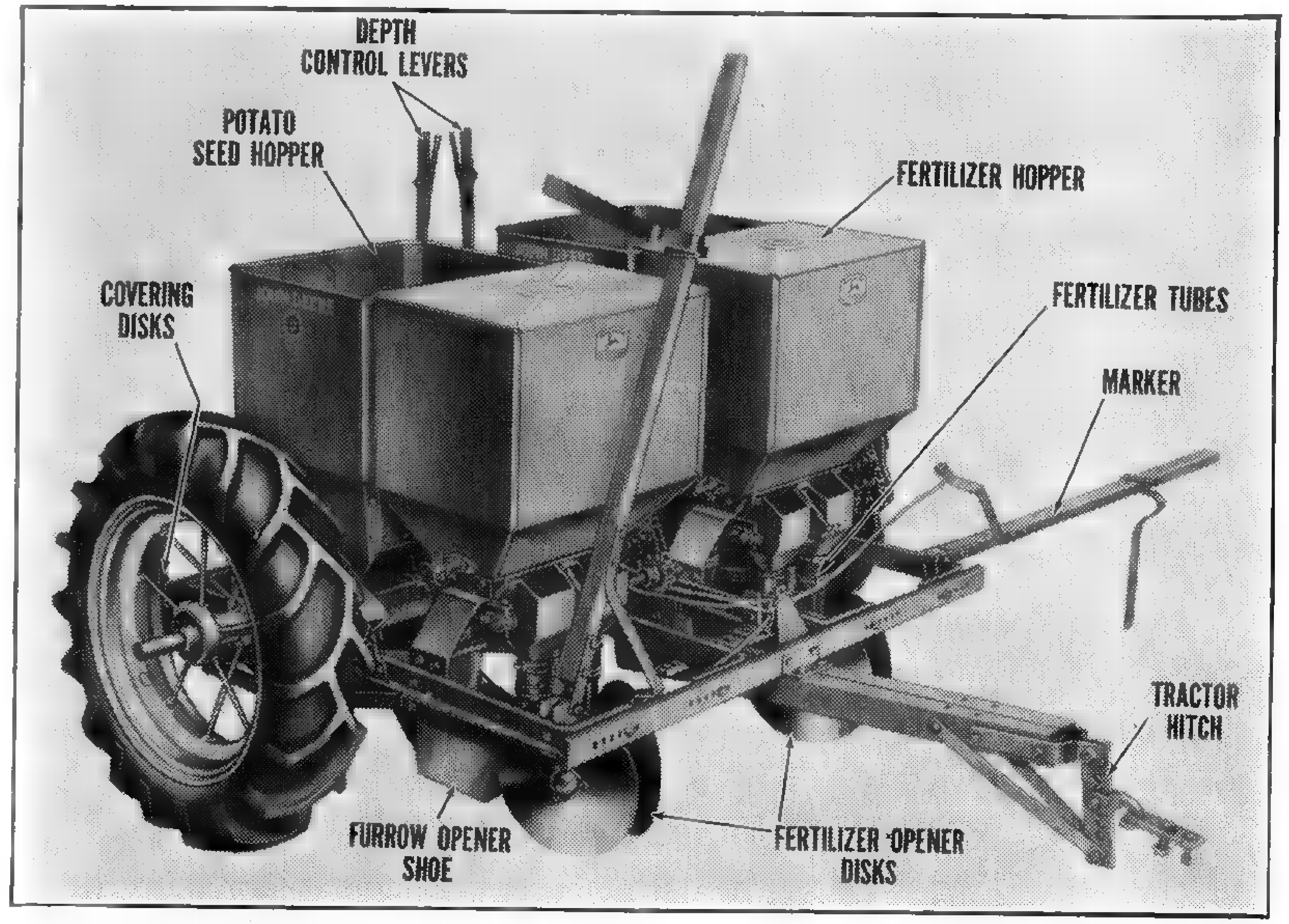


Figure 139—Two-row tractor potato planter with important parts indicated.

and labor, and bigger yields, because of uniform planting and covering, are two advantages derived from the use of a potato planter.

Types of Planters. The type of potato planter in common use is illustrated in Fig. 139. It is well adapted to planting conditions in practically every potato-growing section. A fertilizer attachment that deposits fertilizer on each side of the furrow and mixes it properly with the soil can be added, making a two-purpose machine that is both practical and economical.

Figure 140—The tractor planter is equipped with 12 picker points to insure effective, accurate planting at tractor speed.

When potatoes are raised on a large scale, two-row planters of this type are used with a big saving in time and production costs.

Principle of Operation. Potato planters of the one-man, or picker type, shown in Fig. 139, have often been described as "almost human" in their work of picking out a piece of seed and dropping it in its proper place. Their work is more difficult probably than that of any other planting machine because of the irregularity in size and shape of the seed they are required to plant.

The picker wheel is shown in Fig. 140. Picker arms, revolving on the main axle, pass through the picking chamber containing the seed. Each picker arm is equipped with two sharp picking points which pick out one piece of seed. As the arm passes downward, the seed is forced off the picker points. The seed drops into the trench made by the furrow opener where it is covered by the disks at the rear.

Adjustments are provided to meet planting conditions encountered in any section of the country and under varying field and seed conditions.

Proper Feeding Necessary. One of the important requirements for accurate planting is the maintenance of the proper amount of seed in the picking chamber. In the planter illustrated, the gravity feed, with automatic control, provides a constant flow of seed from hopper to picking chamber.

Figure 141—The two-row tractor planter speeds the work of planting on many large farms.

When the seed in the picking chamber reaches a given level which provides about the right quantity of seed for efficient performance, no more seed will flow into the picking chamber except as required to replace seed planted.

One lever controls opener and disk coverers of each unit on the planter shown in Fig. 139. When these parts are lowered with the lever, the machine is placed in gear automatically. The disk coverers are adjustable for covering at the desired depth.

Spacing of the seed in the row is dependent upon the size of sprocket wheel used on the intermediate shaft. Changing from one spacing to another is a simple operation.

Care Lengthens Life. Like all other machines, the potato planter will last longer and give more satisfactory service if it is oiled properly when in use and when stored. A thorough overhauling before each planting season will add to its efficiency and life.

Questions

1. *What are the advantages of using a potato planter?*
2. *What types of potato planters are used in your community?*
3. *Describe the principle of operation of the potato planter.*
4. *Why is proper feeding necessary?*
5. *Describe, in general, the operation of a potato planter.*

PART FOUR

CULTIVATING

Proper cultivation of row crops during the growing season has much to do with the yield and the quality of the crop produced. This fact is apparent to anyone who has observed the results of good cultivation and of poor cultivation in adjacent fields. Corn, potatoes, or any other crop that is smothered by weeds will produce little compared with the well-cultivated crop.

The destruction of weeds is the primary purpose of cultivation. Weeds draw moisture and plant food from the soil, robbing the growing crop. Weeds are truly thieves in the fields; they steal profits when permitted to grow unhampered.

Cultivation serves two other purposes as well. It creates a moisture-saving surface mulch and admits air and light to the soil. If the soil becomes crusted after a rain, it should be

Figure 142—Cultivating speeds up when the tractor cultivator takes over this important job.

broken into a mulch to prevent the escape of moisture through capillary attraction. Air and light are essentials to plant growth and are admitted to the soil more readily when the surface is loose and ridged.

The first requirement of a cultivator is that it be quickly and easily adaptable to varying field conditions. The operator will find it impossible to cut out all the weeds and stir the ground evenly unless his cultivator is adjusted properly. Angle of the shovels must be correct for efficient work. Quick, easy adaptability to all conditions is the most valuable attribute of a cultivator.

Chapter IX.

ROTARY HOES

Although not strictly a cultivator, the rotary hoe must be classed as a cultivator because of the work it does. Its main purpose is to destroy weeds and create a surface mulch.

The rotary hoe has proved itself of considerable value when used in the early stages of crop growth, this being

Figure 143—Rotary hoe attachment for integral tool carrier in transport.

especially true in corn and other row crops. It is also used, with success, in small grain crops and in any condition where it is desired to break up a crusted surface soil. It is used to best advantage after heavy rains have packed the ground and created an unsatisfactory surface tilth.

Hoe Teeth Stir Soil. The rotary hoe is made up of two series of hoe wheels, one series mounted on the front gang axle and the other on the rear gang axle, spaced so the rear wheels work the soil left between the front wheels. Each hoe wheel has 16 teeth, shaped like fingers, which penetrate and stir the soil as the wheels rotate. A thoroughly pulverized surface results; weeds are uprooted and the soil is left in good condition for plant growth.

While its work is most satisfactory when crops are just coming through the ground, the rotary hoe is used to good advantage in stimulating the growth of crops after they have passed this stage. Some farmers report satisfactory results using a rotary hoe in corn that has reached a height of ten inches.

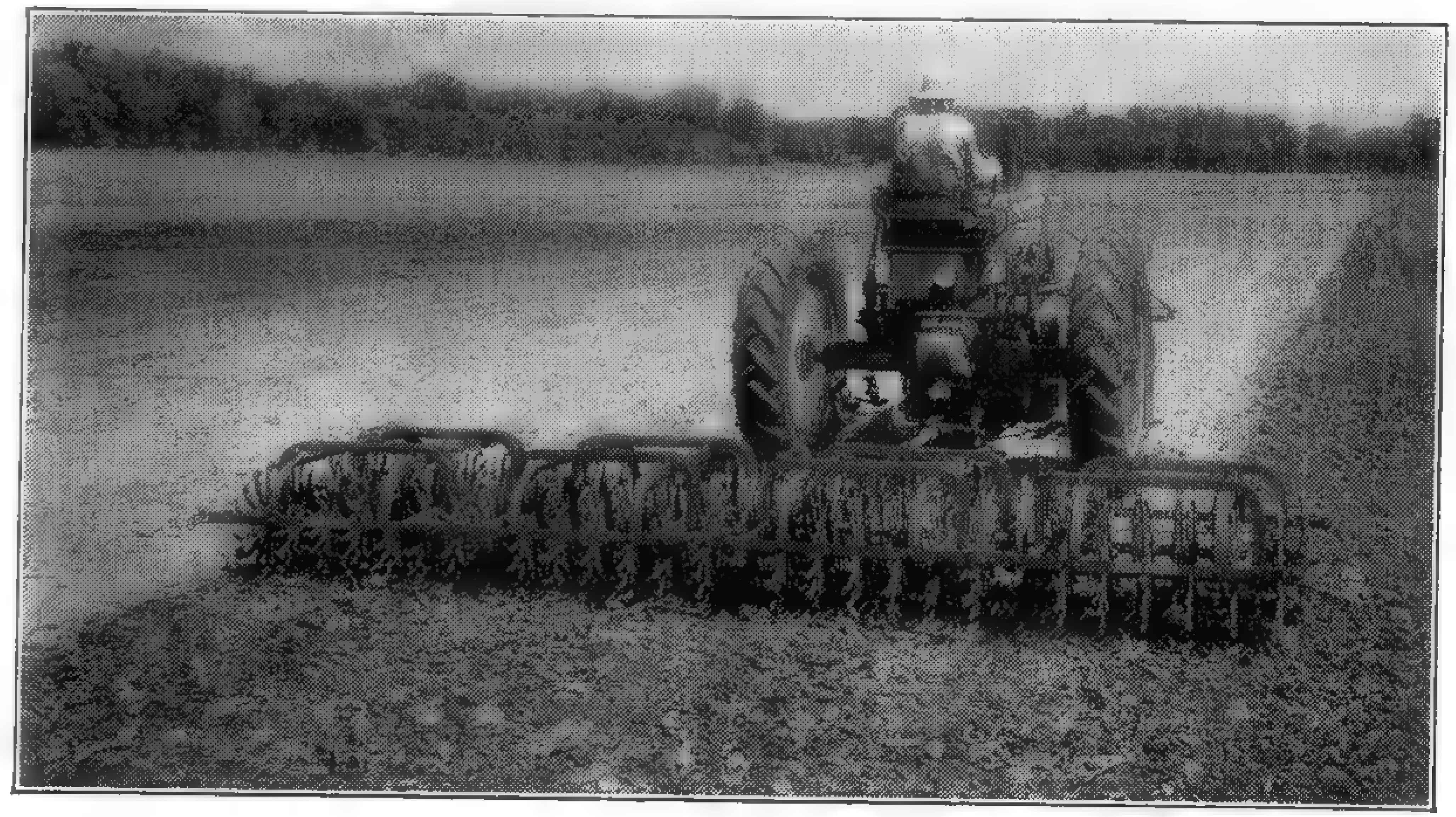


Figure 144—The four-row drawn-type rotary hoe working in small corn.

Three sizes of rotary hoes are in general use—the two-row, the four-row shown in Fig. 144, and the six-row. The larger sizes are probably more economical for the average farmer because of their greater capacity. On large farms, where extra capacity is desired, the practice of operating special hookups of two or three rotary hoes behind the tractor is growing in popularity. Special hitches for this purpose are furnished by the manufacturer.

Easy to Operate. The rotary hoe is easy to operate and adjust. Once the machine has been set at the proper depth, the operator has little to do but drive his tractor.

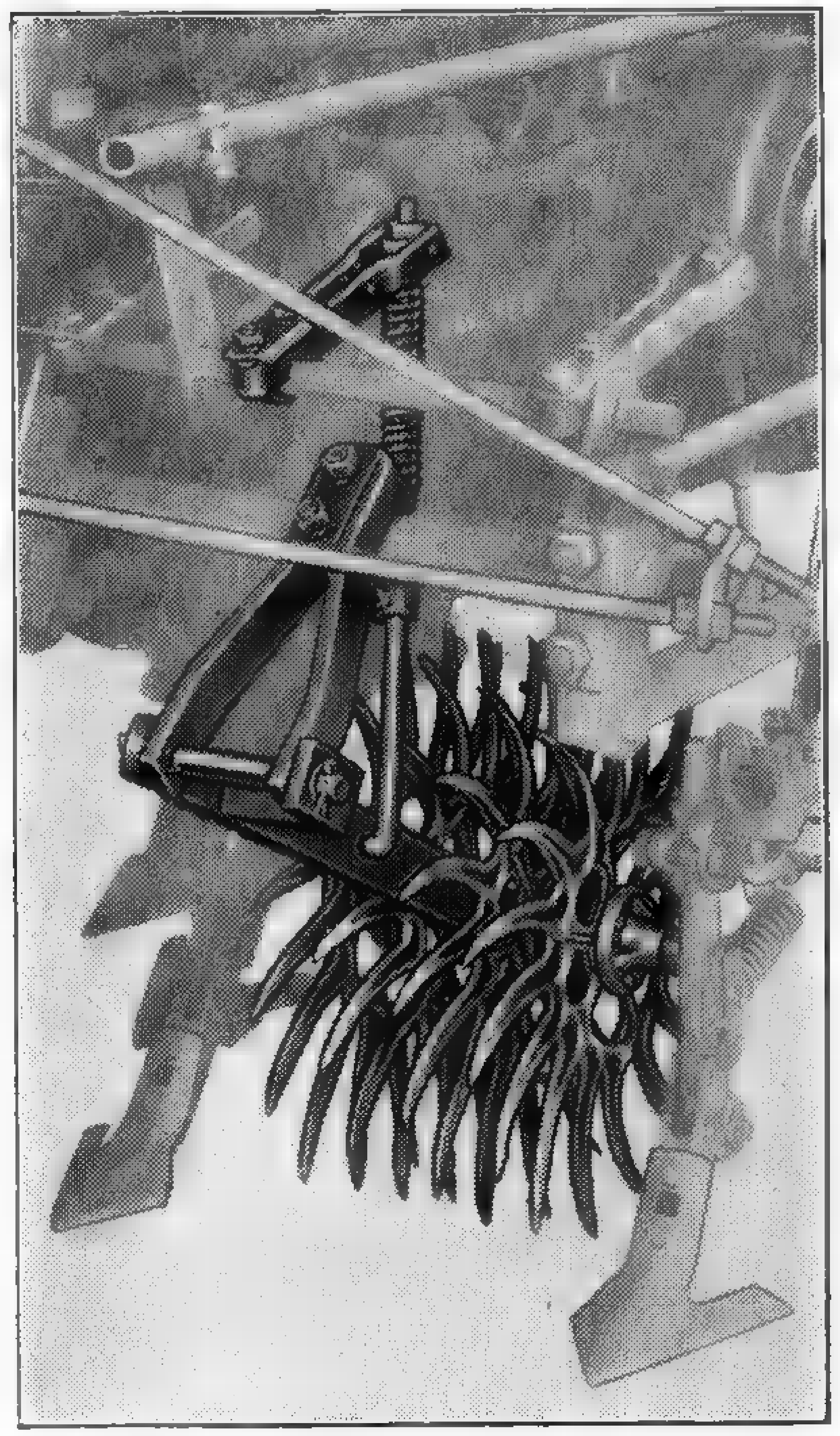


Figure 145—The rotary hoe attachment for the integral tractor cultivator.

Rotary Hoe Attachment for Cultivators. Some integral tractor cultivators can be equipped with rotary hoe attachments, as shown in Fig. 145.

With this equipment, the operator is able to speed up first cultivation without danger of covering the young crop and cultivate all the ground, including the ground in the row. This is especially advantageous in crops that have been drilled or hill-dropped. The attachments can be varied for early or late cultivation.

Questions

1. *Describe the action of a rotary hoe.*
2. *Under what conditions do rotary hoes do the best work?*
3. *What crops are cultivated with rotary hoes in your community?*
4. *What sizes of rotary hoes are in common use in your community and which is most popular? Why?*
5. *What are the advantages of using a rotary hoe attachment on the tractor cultivator?*

Chapter X.

ROW-CROP CULTIVATORS

Row-crop cultivators are the most generally-used type in the majority of farming communities, since they are suited to practically all soils and to average conditions. They are available with a wide variety of shovel equipment for thorough work in all crops and soils.

Its adaptability to cultivating row crops is one of the chief reasons for the broad acceptance of the general-purpose type of tractor, especially in territories where row crops predominate. Field experience has proved that tractor cultivators affect great savings in time and labor.

Owners of tractor cultivators find they can put in more hours per day in the field. In rush seasons, cultivating can be finished sooner, and the time saved can be utilized in taking care of other crops. When the weather is unsettled, the owner

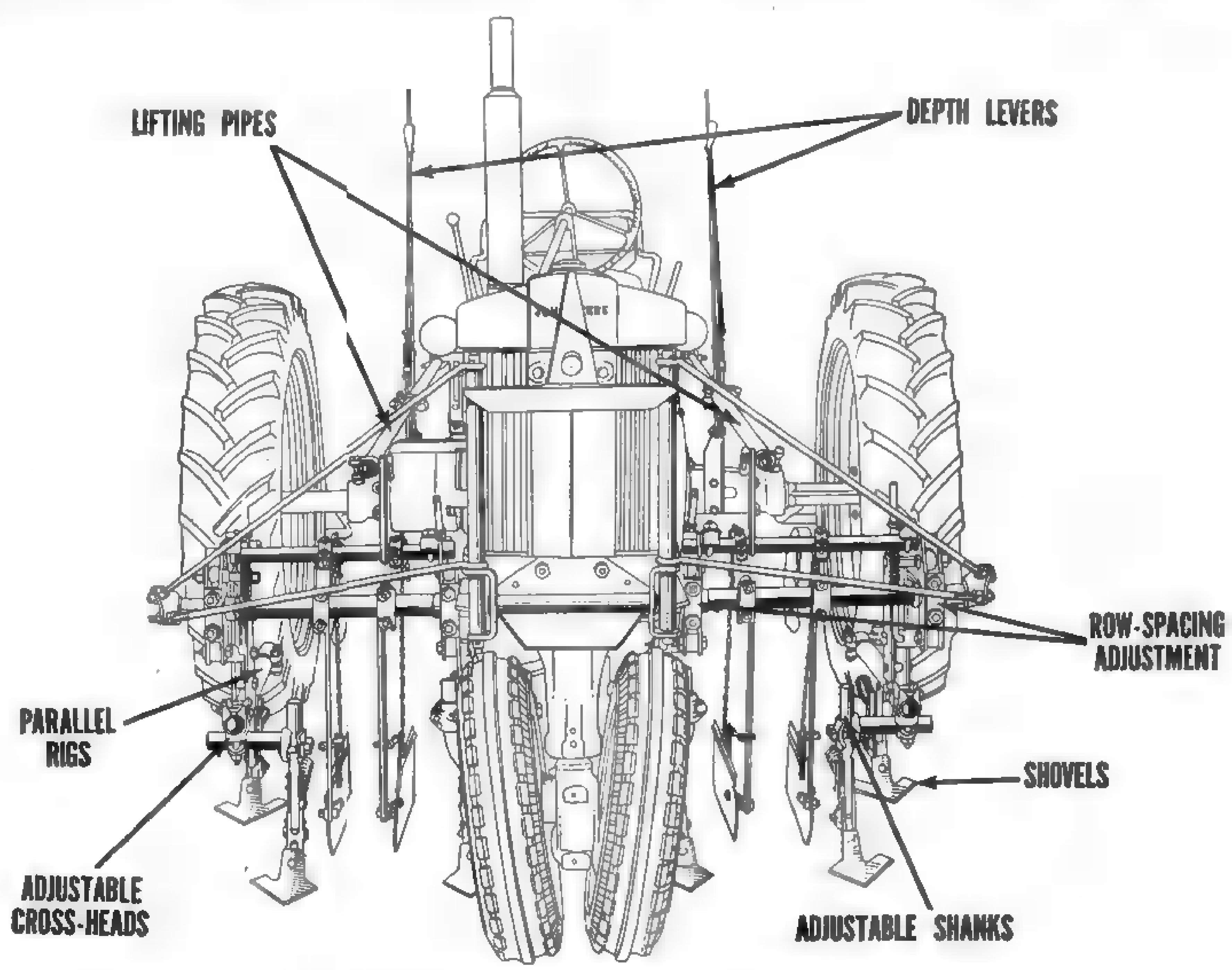


Figure 146—Two-row tractor cultivator mounted on general-purpose adjustable-tread type of tractor.

of a tractor cultivator can take full advantage of favorable conditions.

Operation and Care. The two-row tractor cultivator, shown in Fig. 146, is adapted to use in crops planted with two- or four-row tractor planters. The four-row cultivator, illustrated in Fig. 147, is used in cultivating row crops planted with four-row planters. A special cultivator for use in narrow row crops is shown in Fig. 14. These cultivators form a single unit with the tractors and are controlled entirely from the tractor seat. The entire unit steers with the tractor; once the equipment is properly set, the operator's only duty is steering the tractor and touching the hydraulic control lever or pulling the lift lever to raise the cultivator at the row-ends.

The entire cultivator is removed without disturbing row spacing or other adjustments and may be kept in shed or lot as a complete unit, ready for work. To attach, the operator simply drives into the cultivator unit until the side frame

Figure 147—Four-row tractor cultivator on a general-purpose, adjustable-tread tractor. This big-capacity type outfit is becoming more popular each year.

bars are snug against the tractor frame. A single bolt holds each side of the unit to the tractor.

The frame of the four-row cultivator is rigid, flexibility being obtained through the floating construction of the rigs. The depth of cultivating is controlled automatically by individual gauge wheels, the rigs following the contour of the field as the tractor moves along.

When the operator reaches the end of the field with the hydraulically controlled cultivator, he touches the control lever which sets the hydraulic power into action. The lift raises all the rigs —the turn is made without stopping—the operator touches the lever again and the rigs lower to work.

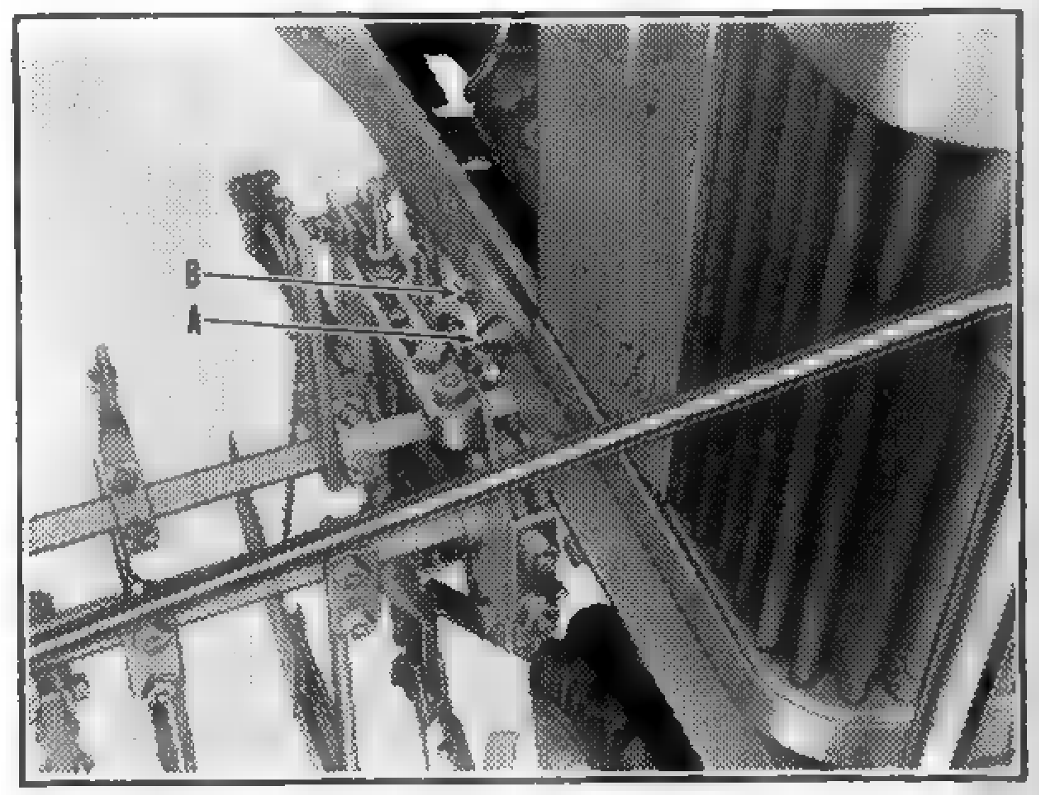


Figure 148—Cultivator side frame bar slips over pilot pin (A) and is held securely by a bolt through tractor frame and cultivator side frame bar at (B).

The shovels used on the tractor cultivators, shown here, are described in the following paragraphs. They are built with extra strength for tractor power. Spring trips protect the shovels and shanks against breakage. On the spring-tooth type cultivator, popular in many sections, the spring teeth act as the safety factor to protect cultivator from breakage.

Adjustment of Shovels. When a cultivator is set properly for working in ordinary conditions, all shovels will penetrate well, run at the same depth without crowding toward or away from the row, and there will be no unnecessary draft. To set and maintain a cultivator in this desirable adjustment is comparatively easy, once the operator understands the causes of trouble and the adjustments provided on his cultivator for correcting them.

One of the most common adjustments that cultivator operators have to make is setting the shovels for proper penetration and uniform depth. The first requirement of an efficient shovel is that it be sharp, with the point properly shaped. A dull shovel will not penetrate easily; it does poor work and causes heavier draft. Fig. 149 shows a properly-shaped shovel with a dotted line showing its shape when point is worn and dull. Frequent sharpening of shovels will insure a smooth-running, good-working cultivator.

Pitch of Shovels. All cultivators are provided with an adjustment, either on the shovel shank or sleeve, whereby the pitch or angle of the shovel can be changed. This adjustment is correct for average soil conditions when the cultivator leaves the factory. However, it may become changed and it is well to know what the proper pitch is and how to get it when conditions demand.

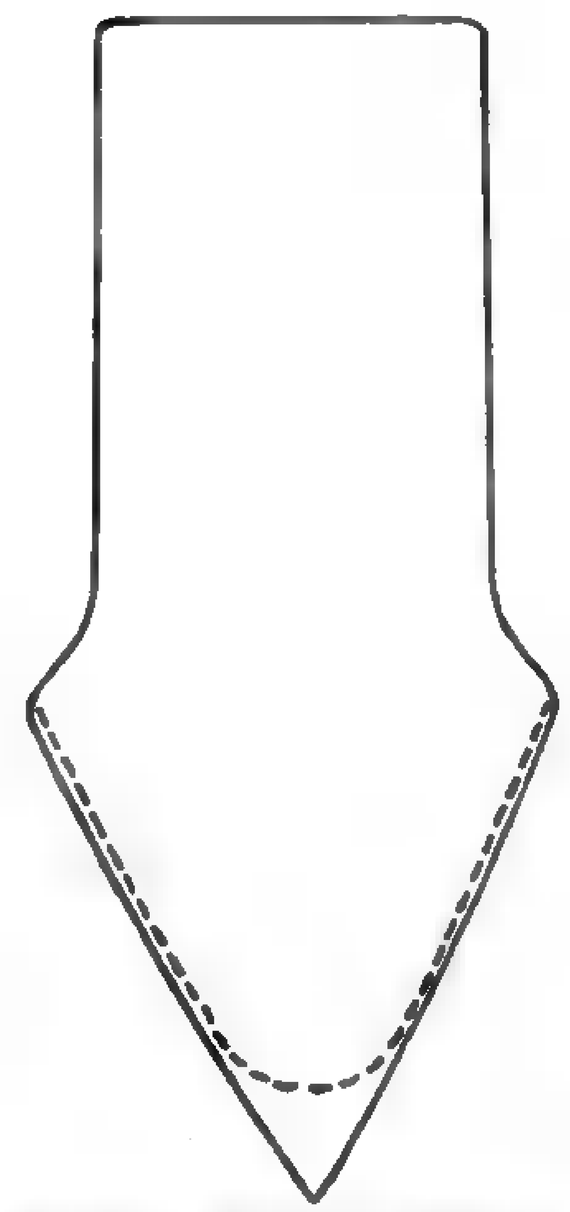


Figure 149—Cultivator shovel with dotted lines showing how point looks when shovel needs resharpening. Obviously, a shovel in this condition penetrates poorly and increases draft.

If a shovel stands too straight, it will not penetrate readily; it will not run steadily. There will be a tendency to skip and jump, and it will require unusual pressure to keep the shovels at work. If set too flat, the underpart of the shovel will ride below the extreme point and the shovel will not penetrate unless forced into the ground.

The illustrations in Fig. 150 show the proper pitch of shovels for good work compared with shovels set too straight and too slanting.

In hilling row crops, it is necessary to turn the front shovels in by loosening the clamp attachment on the shank. This setting tends to pull the shovels away from the row. This tendency does not interfere with the work of a pivot axle

cultivator, but with the swinging rig type; the operator finds difficulty in keeping the rigs running the proper distance from the row when spread arch is not used. An opposite effect is produced when the front shovels are turned away from the row for first cultivation. In either case, the crowding tendency can be overcome and the rigs made to run straight by turning the rear shovels to an equal angle in the opposite direction. On parallel rig types of cultivators, turning the shovels in or out does not affect the operation of the cultivator.

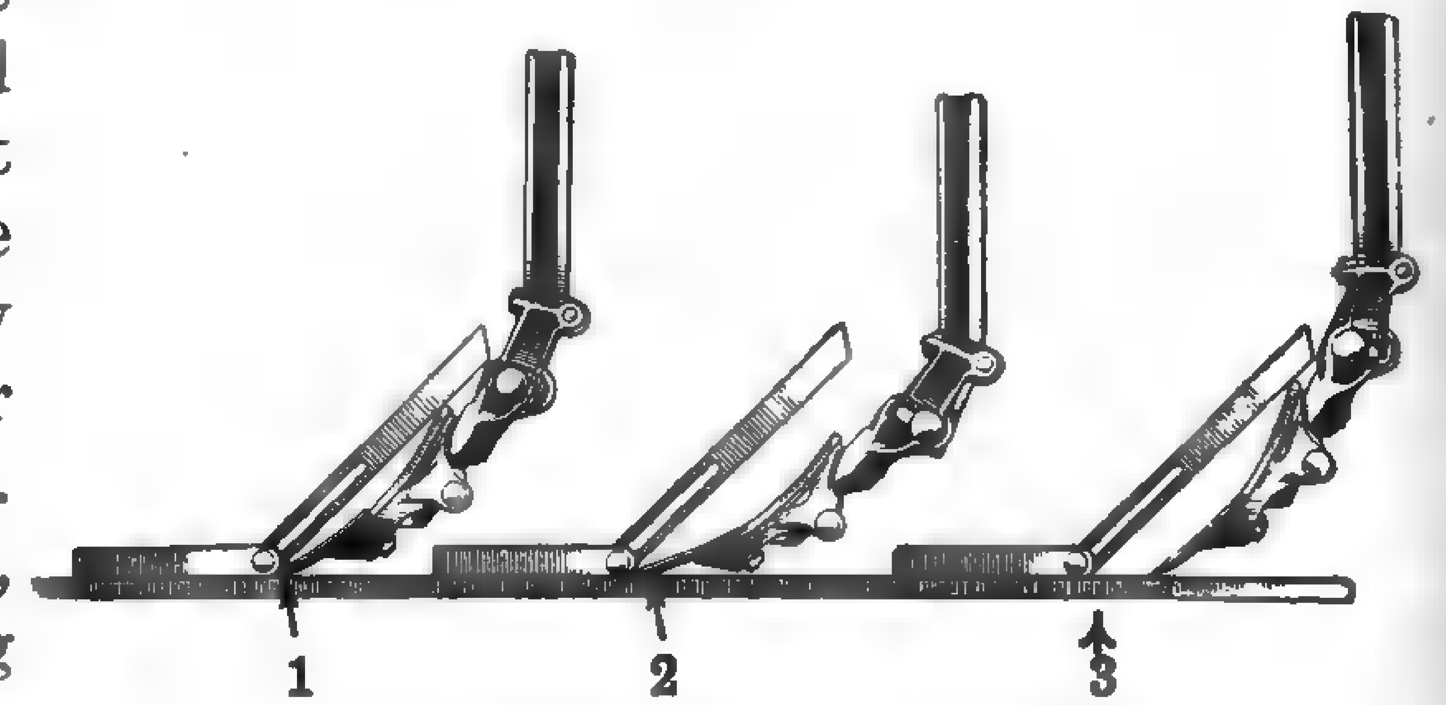


Figure 150—Showing correct and incorrect pitch of cultivator shovels. No. 1, shovel properly adjusted; No. 2, shovel set too flat, will not penetrate well; No. 3, shovel set too straight, will not penetrate or run steadily.

Care of Cultivators. Like all other farm implements, the length of life and the satisfaction given by cultivators depend upon the way they are handled and the care given them during operation and storage. A few minutes given to inspection and tightening of all parts and thorough oiling at regular intervals while in the field will add to the service of a cultivator and save delays caused by breakage and wear. Shovels should be polished and coated with oil when standing overnight and covered thoroughly with heavy grease when stored.

As stated previously, one of the most important factors in efficient cultivation is keeping the shovels sharp. A dull shovel is as inefficient as a dull knife. It is advisable to have the shovels sharpened and shaped by a good blacksmith during the storage season. If the points are too badly worn, new shovels or new points (for the slip-point type of shovel) should be obtained. If the shovels have become rusted and

pitted between seasons, they should be polished before being taken into the field.

It is advisable to go over the cultivator thoroughly, during the slack season, ordering new parts wherever needed and tuning it up ready for the first day of the cultivating season.

Questions

1. *What are the purposes of cultivation?*
2. *What are the requirements of a good cultivator?*
3. *What are some of the advantages of owning a tractor cultivator?*
4. *How is the cultivator guided?*
5. *Why is it necessary that a tractor cultivator have flexibility?*
6. *How is the cultivating equipment, on the cultivators illustrated, raised and lowered?*
7. *How would you adjust depth of each rig, individually; all rigs at one time?*
8. *Why is it important that cultivator shovels be kept sharp?*
9. *What relation has the pitch of a cultivator shovel to its work?*
10. *How would you set shovels to cause the rigs to run straight when hilling?*
11. *Tell how you would care for a shovel cultivator when in use and when placed in storage.*

PART FIVE

HARVESTING

Harvest season is the busiest time of the year on every farm. All hands are turned to gathering the returns of the year's work. Hay, grain, food crops, and fruits must be harvested at the proper time if losses are to be avoided.

When the small grain is ready to be harvested, a delay of a few days may cause heavy losses. Hay must be cut, cured, and stored in the shortest possible time to retain its maximum feeding value. Fruits are ripe and must be picked for the market. All forces should work in harmony at the harvest.

Then, too, farm machines must be at their highest state of efficiency. Combines, mowers, rakes, balers, corn pickers, and all other machines must be tuned up in advance for speed and good work. The operator must know how to make adjustments and repairs to get the most from his machines. He should be familiar with causes of inefficiency and know how to correct them with a minimum of effort and time.

Harvesting machines are probably the most intricate of all to adjust and operate. However, once the operator knows his machine and the adjustments that must be made most often, efficiency is maintained with little difficulty. The most common causes of trouble in harvesting machinery can be avoided by thorough and regular oiling, by replacing worn parts before they affect the machine's operation, and by an occasional complete overhauling and adjustment of parts.

Chapter XI.

MOWERS

One of the most universally-used implements on the farm today is the mower. Obviously, the operation, care, and repair of the mower should be a matter of general knowledge among farmers. Heavy draft, ragged cutting, and excessive breakage can often be avoided by using the maximum care in lubricating, adjusting, and replacing worn parts. A smooth-running, clean-cutting mower gives the owner real satisfaction and requires less power to operate.

Most mowers are basically the same in general design. Therefore, the discussion will be limited primarily to the operation, care, and repair of the semi-mounted type tractor mower.

The tractor mower gives the farmer far greater mowing

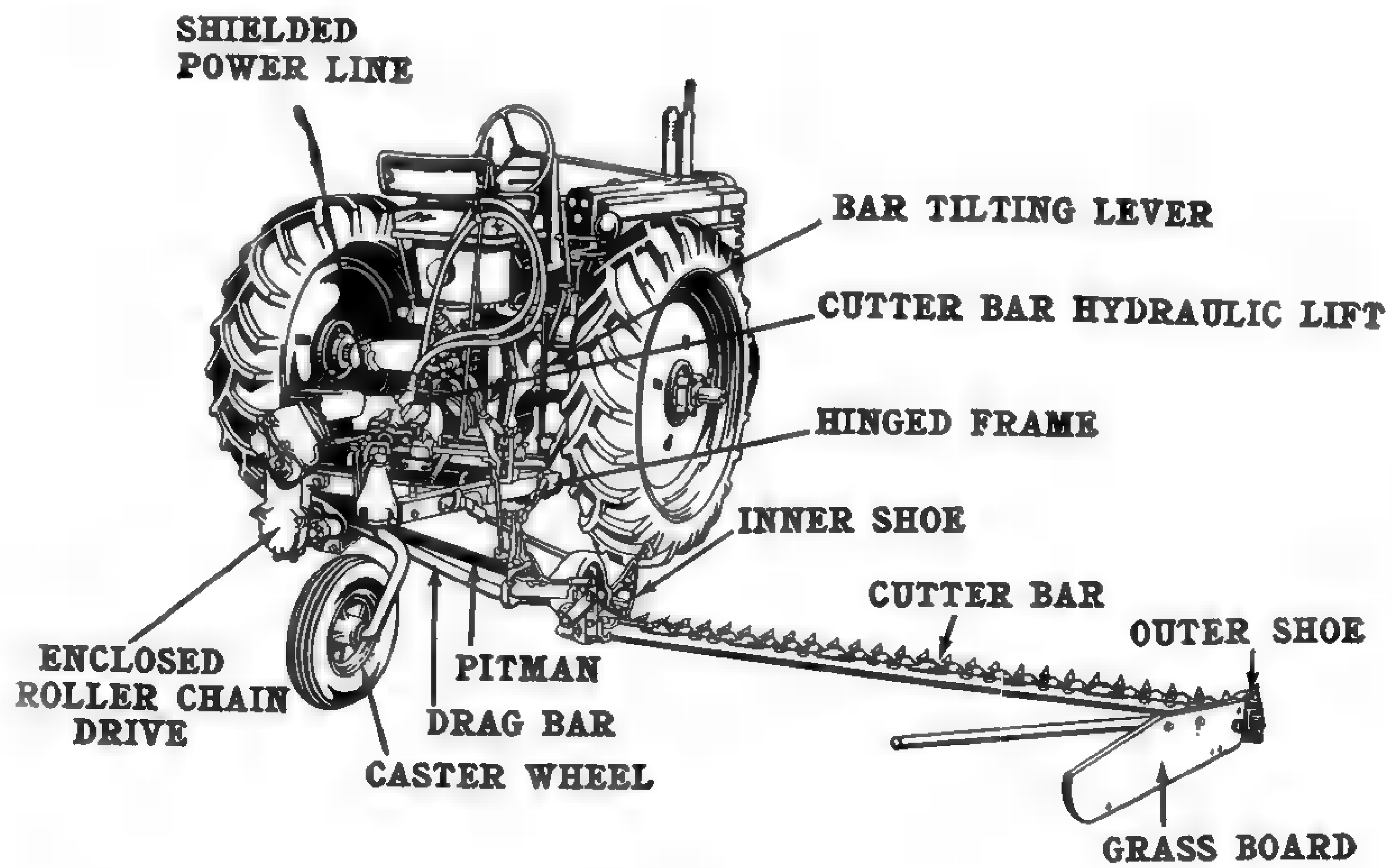


Figure 151—Semi-mounted tractor mower, attached to a general-purpose type tractor. This mower is controlled hydraulically by the remote cylinder.

capacity than the horse-drawn mower. Since the tractor provides constant power to the cutting mechanism of the mower, the knife speed, which is approximately 900 rpm, remains constant regardless of the travel speed of the tractor. Thus, cleaner, smoother mowing is assured. Also, with the greater power available, it is possible to use a larger cutter bar with the tractor mower in most conditions. These factors, combined with faster tractor speeds, enable the operator to increase the daily mowing capacity to 25 to 35 acres a day.

Methods of Attaching Tractor Mowers. Tractor mowers vary widely in method of attaching, in location of the cutter bar in relation to the tractor, and in other minor details. For matter of classification, tractor mowers can be grouped as follows:

Semi-Mounted. This type is also called a trailer mower (see Fig. 151). The front end of the mower is carried on the tractor drawbar; the rear is supported by one or two caster wheels. The cutter bar is mounted between the caster wheel of the mower and hinged hitch bar, connected to the tractor drawbar. The hinged connection provides flexibility in following the contour of the ground; the rubber-tired caster wheel reduces vibration on rough ground.

Most mowers of this type can be quickly attached to practically all makes of tractors providing they are equipped with power take-off. With this type of mower, the cutter bar swings back farther when striking an obstruction; on some popular models, the cutter bar swings back far enough to clear the right rear tractor wheel.

Rear-Mounted. The entire weight of the rear-mounted mower is carried rigidly on the tractor drawbar. It's a lightweight mower with the cutter bar close in to the right rear tractor wheel. Weight of the mower adds weight for better traction in soft or slippery ground conditions. Usually, this type of mower is custom-built for one type of tractor (see Figure 152).

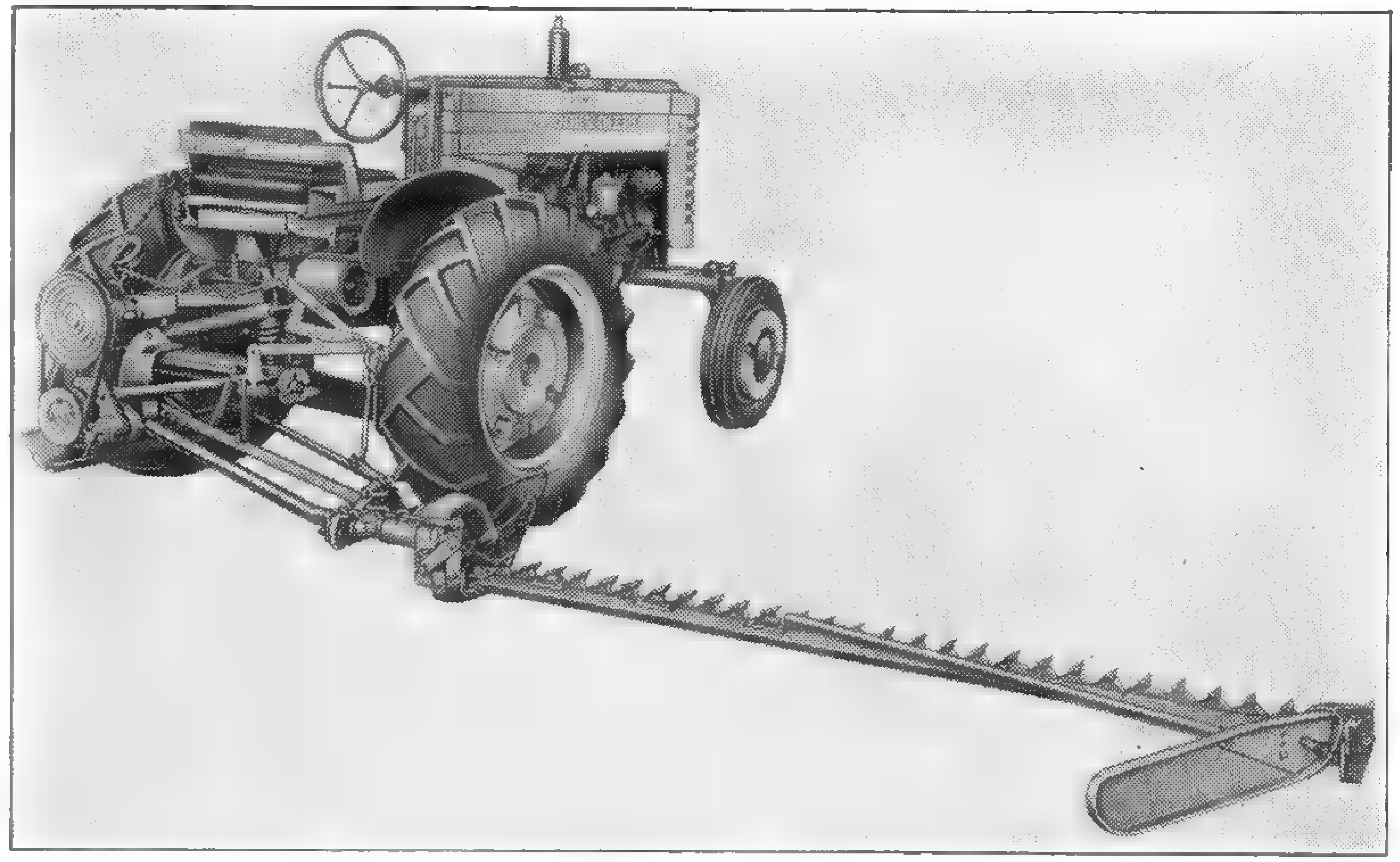


Figure 152—The rear-mounted tractor mower shown [redacted] a smaller general-purpose type tractor.

Center-Mounted. This type of mower is carried rigidly midway between the front and rear wheels of the tractor. This location gives the operator an excellent view of the work . . . permits easier maneuvering for cutting close to and around trees and posts, or along fence rows.

Front-Mounted. This type of mower, mounted on the front of the tractor, is easier to use where there are a number of obstructions.

Operation. Power for operating the tractor mower comes from the power take-off shaft or belt pulley of the tractor. Power for most tractor mowers is transmitted from the power take-off shaft to the pitman through a drive shaft and either an enclosed roller chain or a V-belt drive.

On the chain-driven mower, shown in Figure 153, power is transmitted from the power take-off shaft to the flywheel shaft by an enclosed roller chain. The chain and tapered bearings for the drive and flywheel shafts are all enclosed and automatically lubricated.

A slip clutch in the power line releases automatically when the sickle clogs or when the strain of cutting in tough material is too great. Breakage of parts due to overstrain is practically eliminated if the operator keeps the tension on the slip clutch properly adjusted. Clutch should be tight enough to do ordinary work without slipping, but loose enough to slip easily if clogging occurs. Extreme care should be exercised in making this adjustment—directions furnished by the manufacturer should be followed closely.

With the V-belt-driven mower, shown in Figure 152, power is transmitted from the drive shaft to the flywheel shaft by sheaves and a V-belt. An individual bearing housing contains lubricant for both drive and flywhel shafts. Tension of the V-belt can be adjusted by moving upper bearing housing up or down by means of an adjusting bolt. Since the V-belt allows slippage, should clogging occur at the knife, no slip clutch is required. Correct tension and alignment of the V-belt prolong the life of the belt and

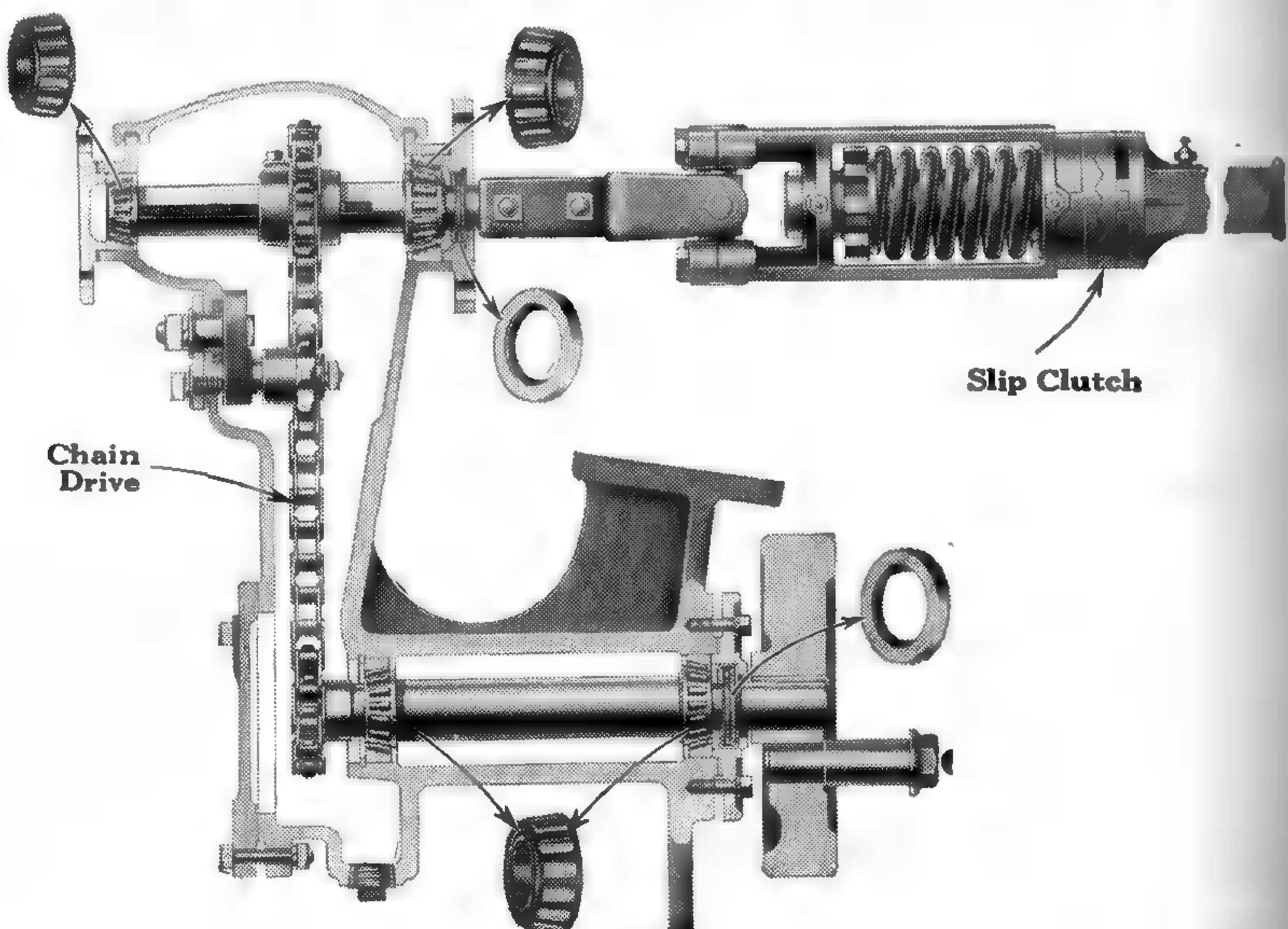


Figure 153—Cross-sectional view of the tractor mower showing the main drive, clutch, and bearings.

protect cutting parts in case of clogging. See the manufacturer's recommendations for adjusting this type of drive.

Safety Releases Protect Working Parts. When the cutter bar of the tractor mower hits an obstruction, a spring release unlatches and permits the bar to swing back, protecting the mower against breakage (see Figure 154).

Figure 154—The safety release permits the entire mower to swing back when an obstruction is hit. Breakage is prevented.

Serving as a latch, the spring release holds the bar in cutting position under all normal conditions but releases when an unusual pressure or shock is encountered. The amount of pressure required to cause the lock to release is adjusted by tightening or loosening a spring tension. The operator must be careful to avoid setting this spring too tight, as such a condition may cause breakage should the lock fail to release.

After the bar swings back, it may be returned to operating

position by backing the tractor until safety latch catches.

Manual or Hydraulic Lift. On most popular tractor mowers, the cutter bar can be raised quickly while cutting for clearing field obstructions such as rocks, stumps, etc., without making it necessary to disengage the power take-off.

Figure 155—High, easy lift provides ample clearance for all conditions.

The cutter bar may be raised by the foot lift for most field operations; the hand lever gives additional lift where necessary. With tractors equipped with hydraulic control systems, the lifting and lowering of the cutter bar can be accomplished by hydraulic power (see Figure 155).

For ordinary field operation, the foot lift raises the cutter bar high enough to meet field conditions. If the bar must be raised higher, the hand lever may be used. The tilting lever controls the tilt of the bar in relation to the ground.

In some conditions, it is necessary to raise the guard points higher than in others. The tilting lever provides this adjustment.

Hydraulic control through the remote cylinder may be applied to the tractor mower to raise and lower the cutter bar and to vary the height of cutting as required. Figure 156 shows the remote cylinder attached to the power mower.

Thorough oiling and careful attention to proper adjustment and repair will increase the efficiency and lengthen the life of a tractor mower.

The tilting lever controls the tilt of the cutter bar in relation to the ground. In some conditions, it is necessary to raise the guard points higher than others; usually a lever provides for this adjustment. For ordinary conditions, guard points should be tilted slightly upward.

The cutter bar and its parts, including the pitman shaft, (see Figs. 157 and 158) make up the most vital unit in mower operation. These parts do all the work of cutting; draft,

Figure 156—Center-mounted mower with a small general-purpose tractor.

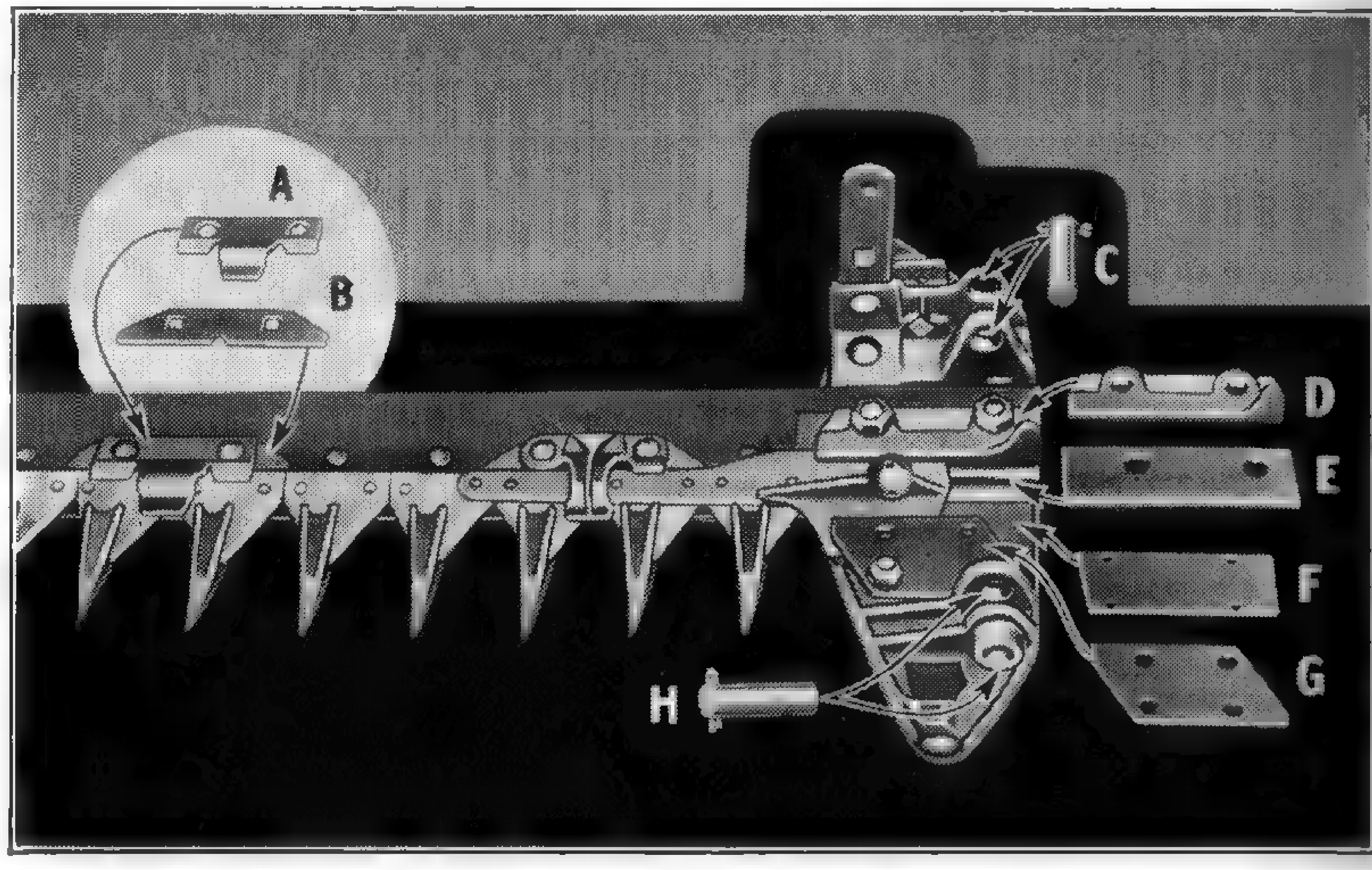


Figure 157—Section of the cutter bar and knife with knife head guides and shoe pins removed and arrowed to show their relation to the cutting parts and to show their long-lived construction. "A" shows knife clip. "B" shows knife wearing plate. "C" and "H" show heavy shoe pins. "D," "E," "F," and "G" show knife head wearing plates.

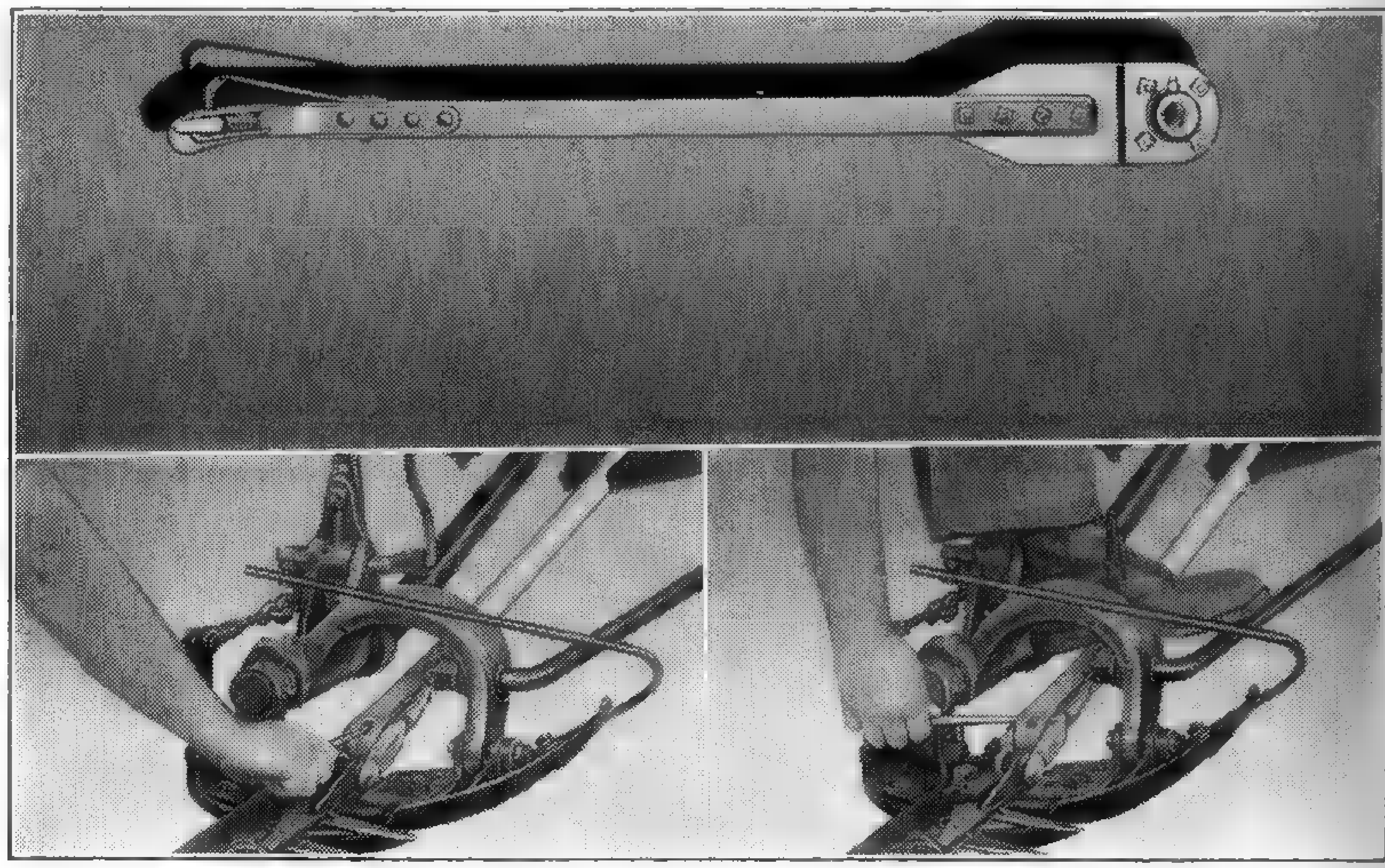


Figure 158—Pitman. At the left: by inserting a punch into the slot and pressing down the pitman, straps are forced apart and held open for release of knife head. Straps can be relocked on the knife head ball by inserting punch under the spreader strap and lifting up, [illegible] shown at the right.

repair costs, and length of life of the mower depend upon the proper setting and care given them.

Register of the Knife. The knife is the heart of the mower. Its sections must be sharp and firmly riveted to the knife back; the guards, wearing plates, and knife holders must fit to it perfectly, holding it to a shear cut with the guard plates, if its work is to be efficient. Knife head guides must be set properly and bolted.

Register of the knife refers to the position of its sections in relation to the guards when the knife is at the outer end of its stroke and at the inner end of its stroke. Fig. 159 shows the knife in proper and improper register. Each section travels between two guards and the section should be in the exact center of the adjacent guards when at the extremes of the stroke.

If the knife does not register on its outward stroke, that is, if the sections do not reach center of guards, part of the vegetation is not cut. The results are an uneven job of cutting, an uneven load on the entire mower, heavier draft and, often, clogging of the mower knife. An incomplete inward stroke will result in the same troubles.

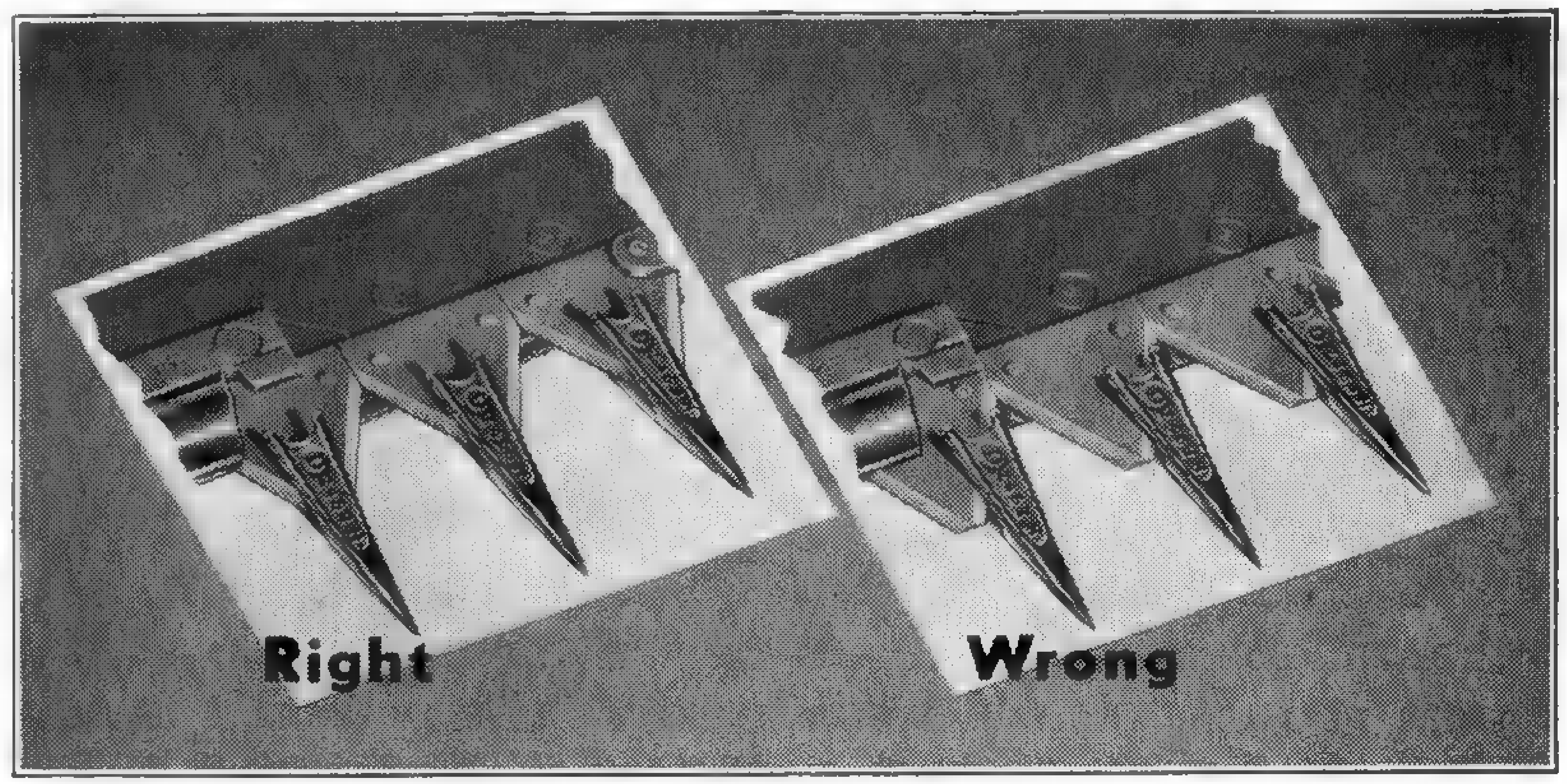


Figure 159—Ragged cutting is usually the result of improper knife register in the guards.

Putting the knife in proper register is accomplished by different methods, depending on the particular mower. However, the principle involved is to move the cutter bar and yoke in or out, as necessary.

First, make sure the mower is attached properly to the tractor and the pitman straps are tight over knife head ball. Be sure the lifting spring has the correct tension and the cutter bar is lowered to the ground. Rotate the pitman flywheel by hand and note the position of the knife sections in relation to guards at the end of the inner and outer stroke. If sections do not center, the knife is off register. If off register, note whether the point of the section is right or left of the guard, as the entire cutting bar must be moved in or out to place guards in the correct position in relation to the knife sections.

The cutter bar may be moved in or out as necessary by transferring forked washers in the yoke on the drag bar and adjusting the pull bar at the flywheel guard. Transferring washers from one end of the yoke to the other provides proper centering of the knife without destroying the correct lead in the cutter bar. The pull bar should be shortened or lengthened by adjusting the socket on bar at flywheel guard to correspond to the amount of thickness of washers transferred. When the mower is old and has had severe usage, pull bar socket connections can be shortened one or two turns more.

Cutter Bar Alignment. All new mowers have a certain amount of lead in the cutter bar; that is, the outer end is set ahead of the inner end to offset the backward strain produced by the pressure of cutting and to permit the knife and pitman to run in a straight line. As the mower wears and parts become loose, the outer end of the bar lags back until the knife is running on a backward angle, causing undue wear and breakage of cutting parts. On mowers illustrated here, this wear may be taken up by turning an eccentric bushing at the rear hinge pin (see Figure 160) to the left

until proper alignment is obtained. For mowers which have no adequate method of compensating for wear, such as an eccentric, new parts should be installed. Usually, realigning pitman and knife restores the original lead of the cutter bar.

In some cases where the wear has occurred at the pull bar connections or when the mower has hit an obstruction, it may be necessary to adjust the pull bar to move the yoke, as well as cutter bar, ahead to original lead. One turn of the pull bar socket gives bar 1/8-inch movement. The outer end of the cutter bar should be ahead of the inner end 1-1/4 to 1-1/2 inches on 5-foot mowers; 1-1/2 to 1-3/4 inches on 6-foot mowers; and 1-3/4 to 2 inches on 7-foot mowers.

To determine the lead or lack of lead in the cutter bar, it is first necessary to check pitman and knife alignment. Oftentimes, as previously stated, when knife and pitman are aligned, original "lead" is restored also. Be sure mower is attached properly to tractor, lifting spring is properly adjusted, and cutter bar is tilted level. Pull outer end of the bar back, taking up all slack due to wear. Tie a cord to pitman bearing box and run cord down the center of the pitman

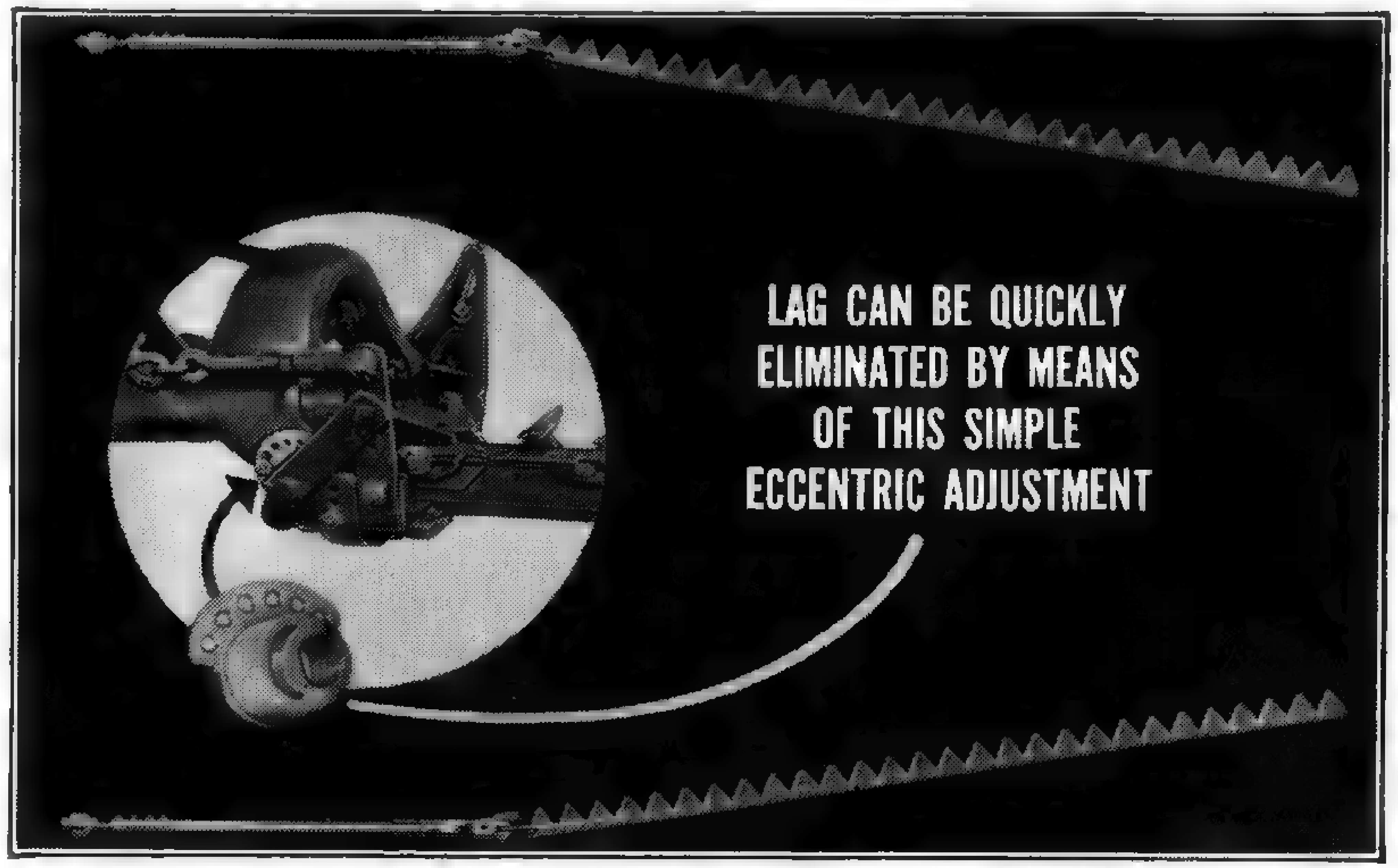


Figure 160—Eccentric is adjusted to the left to take up lag in the cutter bar.

stick and over the center of the knife head ball and out over and beyond outer shoe, keeping it parallel with the pitman. If pitman and knife are in line, the back edge of the knife back should be parallel with the cord (see Figure 161).

If pitman and knife are not in line, turn eccentric bushing around rear hinge pin to the left as far as necessary to bring outer end of bar ahead until knife back is parallel with the cord. After this adjustment, go on and check for proper lead. This is done in various ways according to the type of mower. In the case of the mower, shown in Figure 161, a cord can be stretched across two points of the ground which are established with a plumb bob from tractor wheel rims. With the knife at the outer end of its stroke, measure from cord to back edge of knife at knife head and from cord to back edge of knife at outer shoe. The difference between the two measurements is the amount of lead the outer end of bar has over the inner end. Adjust pull bar to obtain proper lead if necessary.

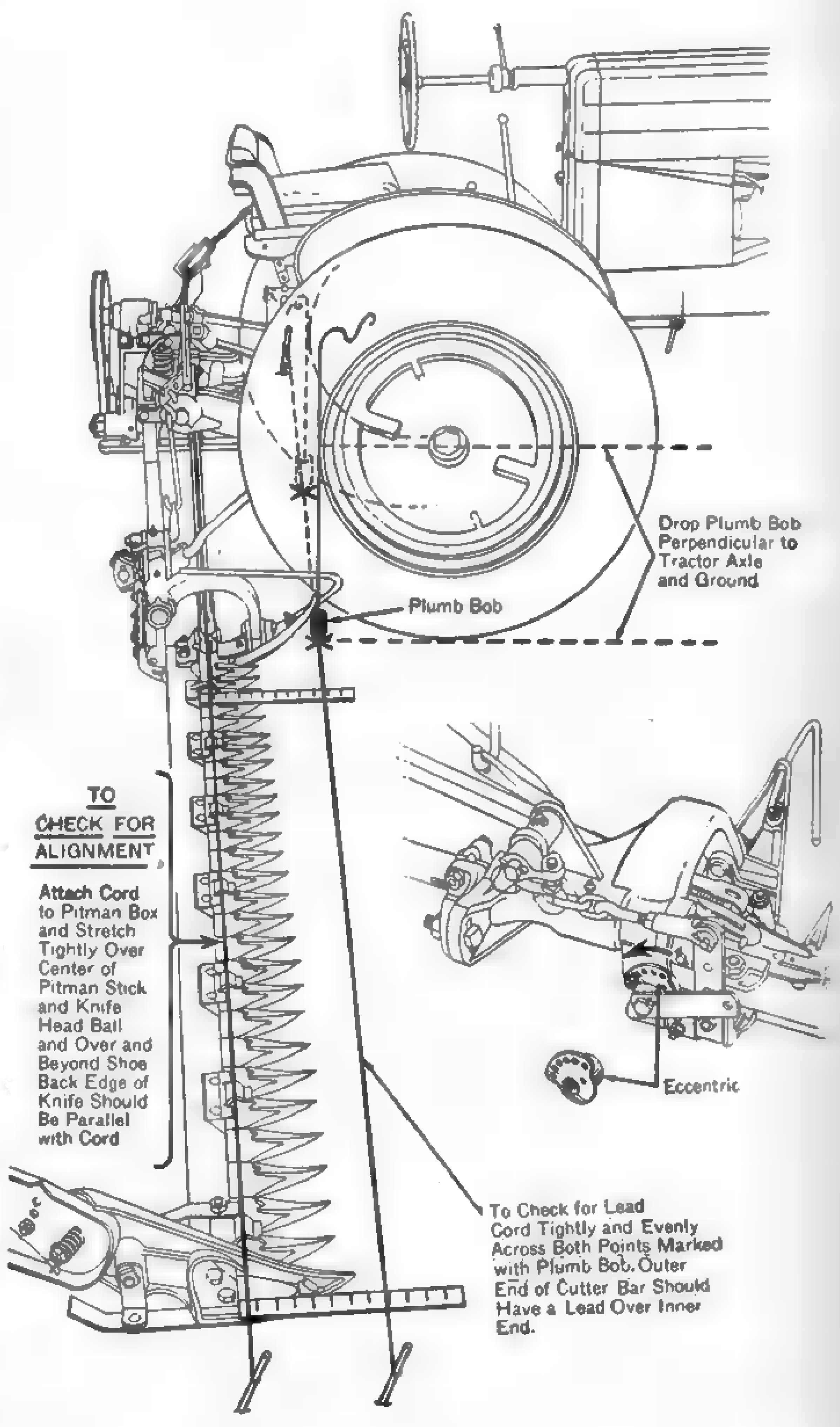


Figure 161—Overhead view of a mower, showing how to determine lag or lead in the cutter bar.

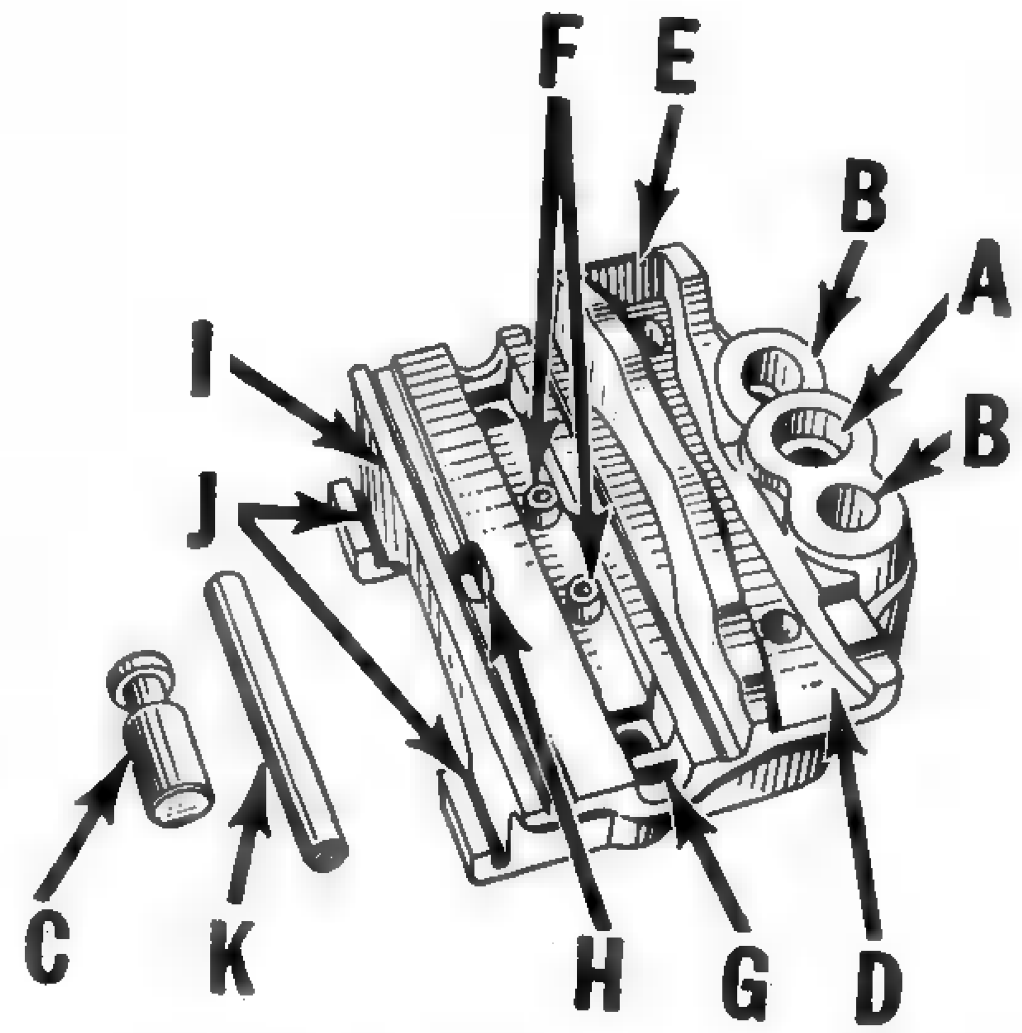


Figure 162—A convenient block for removing and replacing guard plates, knife sections, flywheel wrist pins, and for straightening knives.

Hole "A" is used for riveting wrist pin to flywheel. "B" indicates holes for guard plate riveting post "C." "D" anvil for mower guard. "E" anvil for combine or binder guard "F" removable hardened riveting posts. "G" is a groove for the knife back. "H" indicates hole through which sheared rivets are driven.

When shearing sections, the knife back rests on edge "I" The grooves "J" steady the knife. "K" is the rivet set used in completing the job of riveting.

Pitman Adjustment. The mower operator must keep the bolts that connect the pitman to the pitman box and knife head at proper tension for good work. If pitman bolts are too tight, particularly the knife head bolt, the draft will be increased.

The knife head must have a free ball-and-socket action in the pitman straps to accommodate tilting of the bar and the up-and-down-movement of the inner and outer ends of the bar in going over uneven ground.

If the bar is tilted low, a tight pitman connection tends to hold the knife sections away from guard plates. This causes excessive wear and allows the grass to get between sections and guard plates.

If the pitman bolts are permitted to become too loose, or the strap rivets loosen, the pitman and knife are subjected to excessive vibration, which results in heating of pitman box, breakage of parts, and abnormal wear. Operating pitman by hand will usually show whether or not it is in proper adjustment.

A few popular-make mowers, as those shown here, have automatic pitmans which are self-adjusting and require no

attention from the operator. Wear on knife head and pitman straps is taken up by a plunger and and spring tension. This type pitman also can be quickly removed and attached using only a punch to spread or close pitman straps (see Fig. 158).

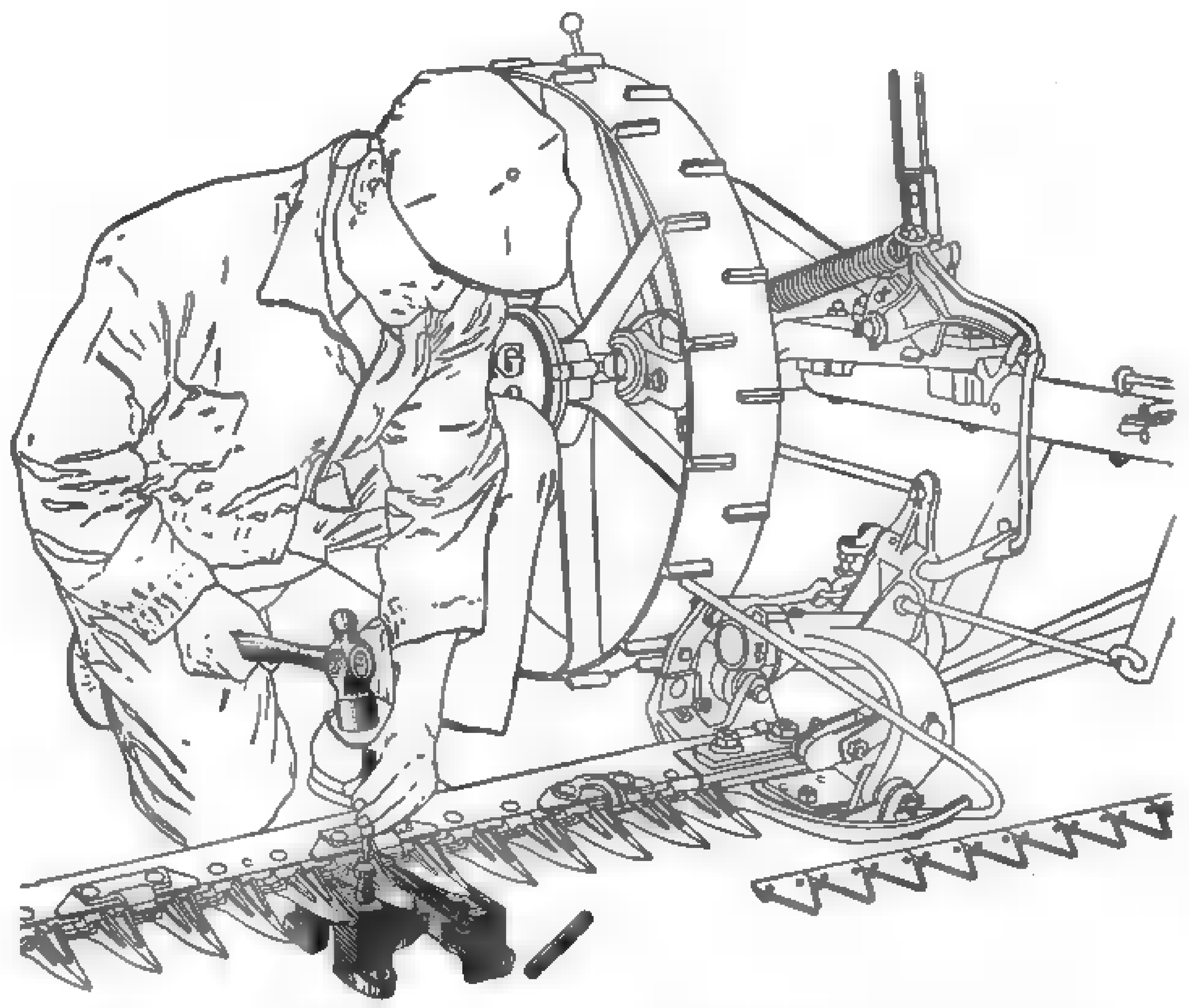


Figure 163—Replacing guard plates in the field with the repair anvil.

Adjustment and Repair of Cutter Bar Parts. When the pitman is properly adjusted and all cutter bar parts are set as they should be, the front end of every knife section rests smoothly on the guard plate, in position to make a shear cut. To maintain this ideal condition, guards and guard plates, wearing plates, and knife holders must be in good condition and correctly set. If these parts become loose or badly worn, the knife will flop around in the cutter bar, chewing and tearing the grass instead of cutting it, causing the mower to pull hard and increasing the possibilities of breakage.

The guard or ledger plates have a very important function in the cutting action of the mower. They act as one-half of the shear, the knife sections acting as the other half. If sections and plates are not sharp or do not fit closely together,

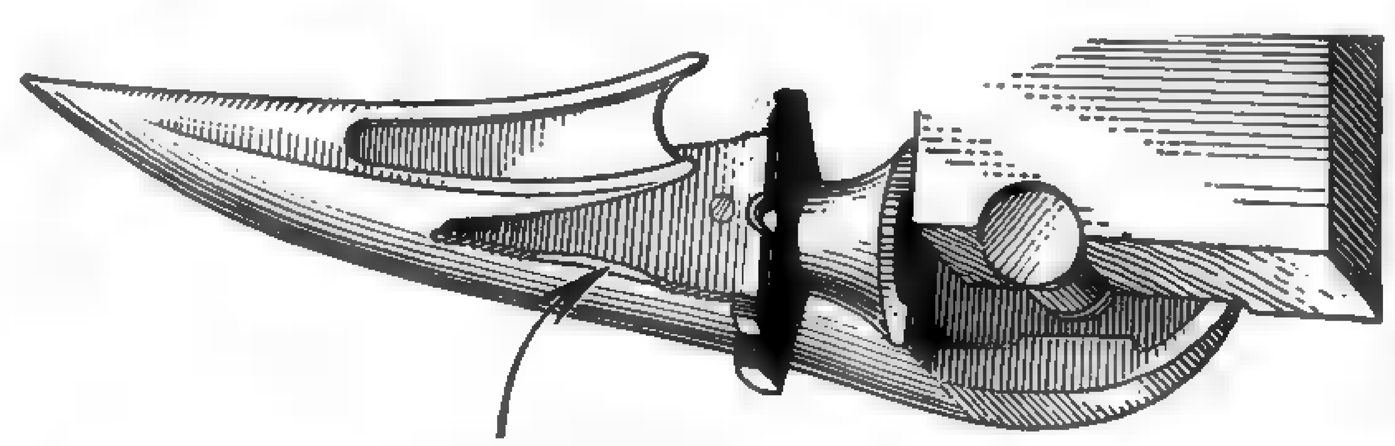
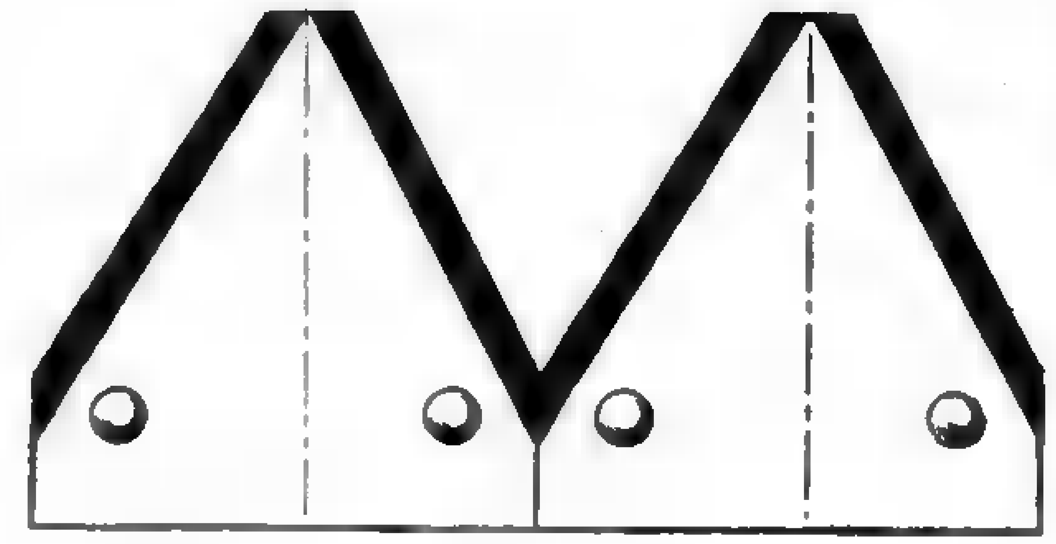


Figure 164—The efficiency of the mower is seriously impaired by imperfect guards.

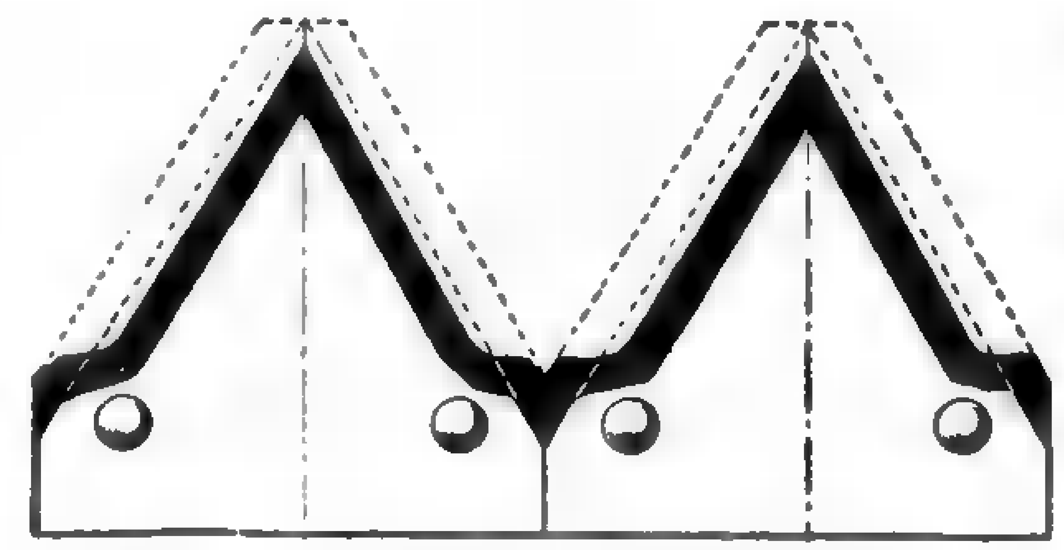
the result is similar to that produced by a dull or loose shears in cutting cloth. Guard plates should be replaced when broken or worn dull and the guards aligned to give a shear cut on every plate. Figures 162 and 163 show a convenient block for replacing plates with guards either on or off the cutter bar.

A dull or improperly-ground knife reduces the efficiency of the mower, results in ragged cutting, excessive and unnatural wear, and extremely heavy draft. By actual dynamometer tests, a dull or improperly-ground knife may increase draft of the mower as much as 30 per cent over the normal draft of a new or properly-ground knife.

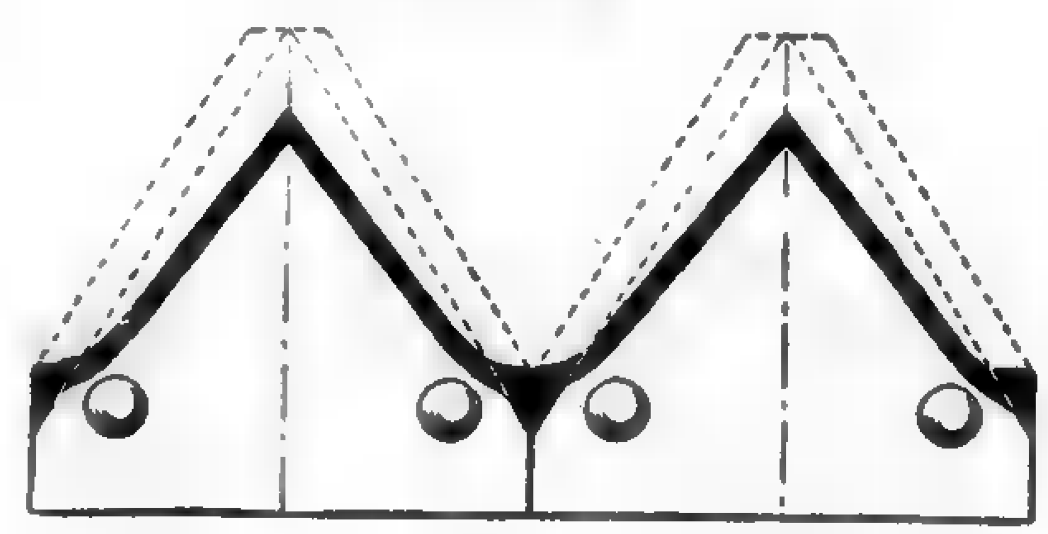
The angle at which the sections work with the guard plates and the angle of the cutting bevel on new sections have been worked out by years of trial and experience; they are practically standard on all mowers. When grinding the knife, it is of utmost importance that



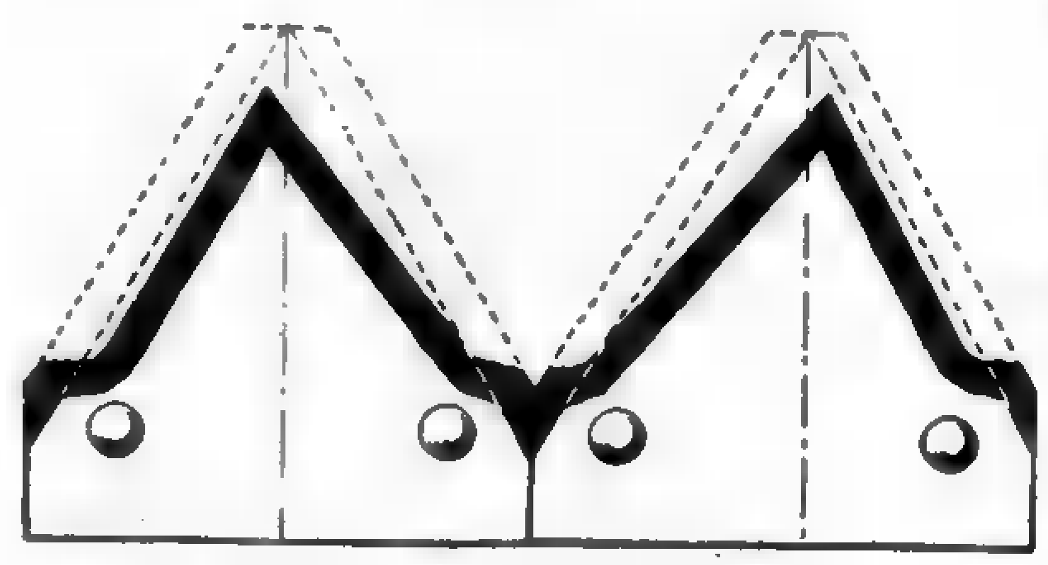
New sections—proper bevel and angle for good work.



Sections properly ground. Even after repeated grinding, proper bevel and angle are retained.



Improperly-ground sections; narrow bevel and wrong angle which changes the angle of "shear."



Sections ground off center, destroying the register of blade in guard.

Figure 165—The right and wrong ways to grind mower knives. Dotted lines show outline of new sections.

these angles be retained if the knife is to be restored to its full efficiency. The angle at which the section meets the guard plate must be such that the grass will not have a tendency to slip away. The bevel of the section is highly

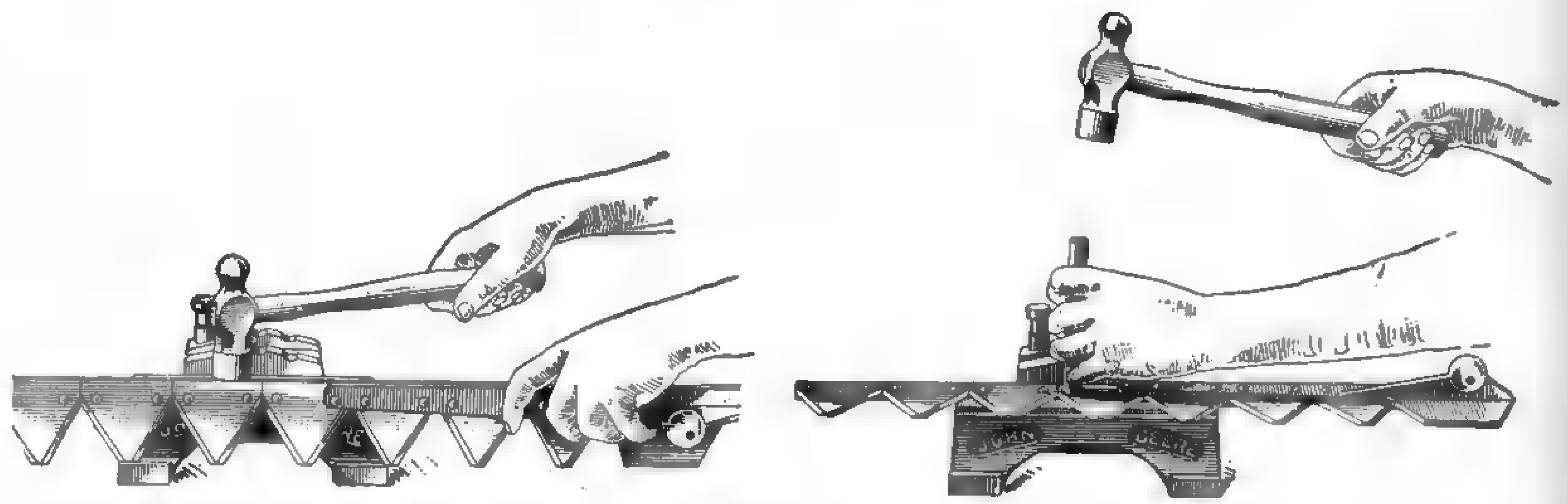


Figure 166—When removing and replacing knife sections, a solid base must be provided to prevent bending or breaking knife back.

important, as an abrupt edge will tend to dull easily and chew the grass, thereby increasing draft; too wide a bevel will cause the section to nick easily (see Figure 165).

Before grinding sections which have been reground

Figure 167—Knife sections ground beyond good service.

previously, it is well to decide whether or not further grinding will be justified. As shown in Figure 165, knife sections are extremely hard along the cutting edge and somewhat softer to provide toughness and shock resistance, in the center. A knife section ground beyond the hardened outer area will not only fail to hold its cutting edge but, in most cases, will be too small for efficient service.

Keeping in mind the importance of retaining proper bevel and angle when sections are sharpened, it is well to select a knife grinder that can be set to restore the sections or original specifications.

When knife sections have been ground to the point where the efficiency of the mower is impaired (Figure 167) or when sections have been broken, the worn or broken plates should be sheared off. With knife back resting solidly on the block, strike back edge of section a sharp blow. This operation will shear the rivets without damaging knife back. Driving out the rivets with a punch not only enlarges the holes, but weakens the knife back.

In replacing the sections, be sure the rivets are *tight* and properly rounded.

Aligning the guards is an important and exacting operation. A new knife, or a straight one that is not badly worn, should be used in testing and setting the guards. Insert the knife and set each guard up or down, as necessary, to make a shear cut between knife sections and guard plate. Guards are malleable iron or forged steel and can be bent without breaking by striking at the thick part, just ahead of plate when guard bolt is tight. Guard wings should also be aligned, making a smooth surface for knife back to work against. Position of guard points should not be considered—the plates and wings are the important units that must be aligned. See Figure 168 for details on proper alignment of guards to produce a shear cut.

It is advisable to replace badly worn wearing plates (see Figures 164 and 168) when guards are repaired. The wear-

ing plates hold the sections in correct cutting position but, when worn, they permit the sections to rise at front end, causing clogging and ragged cutting.

The knife holders hold the sections down against the guard plates. They must be set close enough to the sections to hold them firmly in position when cutting, yet not tight enough to cause binding and heavy draft.

When necessary to set the holders down, the knife should be pulled out—holders should never be set down with knife under them. Starting at holder next to the outer shoe, set each holder down with a hammer, tapping it lightly. Then move the knife under holder to test the adjustment; if it tends to bind, leave knife under the holder and hit the holder on the flat surface between the two bolts. Proper set-

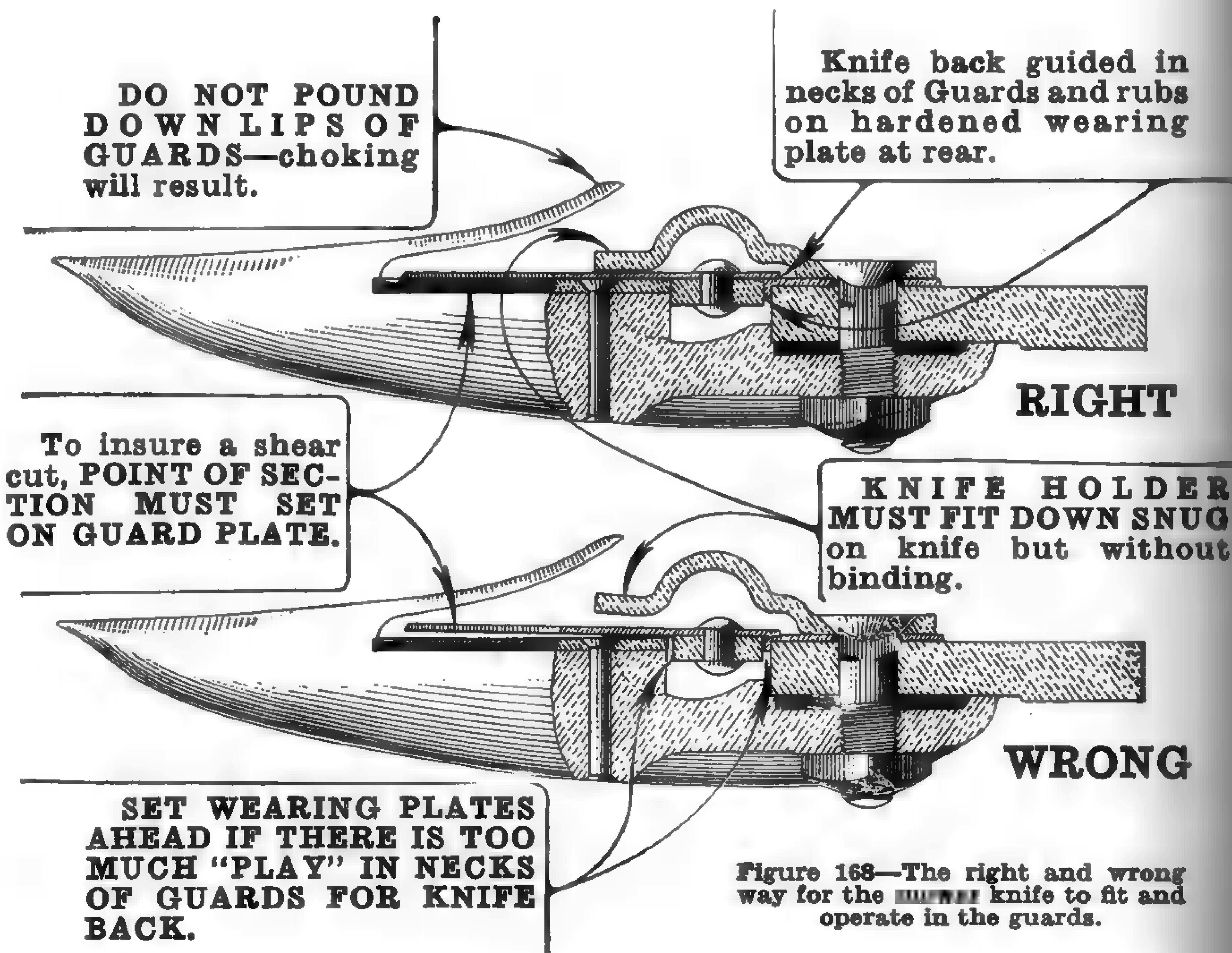


Figure 168—The right and wrong way for the [redacted] knife to fit and operate in the guards.

ting of each holder must be made before moving to the next one.

Lifting Spring. There should be enough tension on the lifting spring to cause the bar to rise easily and move steadily over the ground. With too much tension, the bar will not follow uneven ground and the inner end may be held up after it has passed over a mound or other obstruction. When properly adjusted, the lifting spring carries the bulk of weight of the cutter bar and reduces friction between bar and the ground.

Operation and Care. Mowers require a considerable amount of attention and care when at work. Following are a few hints for mower operators.

See that all moving parts work freely before putting the machine in the field. Keep all nuts tight.

Use plenty of good grade oil, and never let wearing surfaces become dry. Follow carefully the instructions given for lubrication by the manufacturer. Negligence leads to reduced efficiency, heavy draft, wear, breakdown, and costly replacement of parts.

In dry, dusty, or sandy conditions, the cutting parts usually work best without oil.

Be sure mower is correctly attached to the tractor. Check levers and controls often to see that they operate properly.

Avoid excessive travel speeds. Steady work accomplishes more than fast work for a time. Various mowing conditions require different mowing speeds. Best results will be obtained by operating the tractor at the travel speed that will meet crop and field conditions or the speed where the smoothest mowing action results.

Tractor engine should always be kept running at a normal speed. Running the engine slow reduces the knife speed and may cause the knife to clog where cutting is heavy. Where difficult conditions make it necessary to slow down travel speed, the operator should shift the tractor transmission to a lower gear rather than throttle the engine to slow speed.

Questions

1. *Name the different ways a tractor mower can be mounted. What are the advantages of each?*
2. *How is the tractor mower driven?*
3. *What is the purpose of the slip clutch? Why is it necessary that it be properly adjusted?*
4. *What happens when the cutter bar hits an obstruction?*
5. *How is the bar raised? Tilted?*
6. *What is meant by register of a mower knife? What effect does lack of register have upon the work of a mower?*
7. *Tell how you would register a mower knife found to be out of register.*
8. *What is meant by "cutter bar" alignment? How would you test for alignment and how would you take up "lag," if present?*
9. *Why is it necessary to keep the pitman straps in proper adjustment?*
10. *Name the important parts of the cutter bar.*
11. *What is a "shear cut?" What parts must be in proper adjustment for this ideal cutting condition?*
12. *Describe proper procedure for grinding mower knives.*
13. *How are the guards aligned?*
14. *What is the function of the knife holders?*
15. *How would you set the lifting spring for good work?*
16. *What are the most important points in properly caring for a mower?*

Chapter XII.

HAY-HANDLING EQUIPMENT

Hay is a highly perishable crop. It must be cut at the right time, cured properly, and handled carefully from field to feeding rack if its maximum feeding value is to be retained. This is especially true of legume hay, such as alfalfa, clover, and soybean. Timothy, bluegrass, and wild hay are less perishable and do not require such exacting methods of handling.

Since the greater part of the feeding value of legume hay is contained in the leaves, every operation in curing and handling must have as its main purpose conservation of the leaves, along with thorough curing of the stems. High-grade legume hay should have its natural green color, should be fresh and sweet, and should retain all the leaves on the stems without shattering when the hay is handled.

Figure 169—The automatic baler speeds the hay from windrow to bale and reduces time and labor cost.

Modern machines and modern methods of handling hay are used to great advantage in increasing the feeding and market value and decreasing the cost of producing legume hay. The side-delivery rake is considered necessary to the proper curing of legume hay.

The hay baler is gaining in popularity from year to year. While baling does not improve the quality of the hay, it does preserve its quality, makes it readily available for feeding or for sale. When we consider that loose hay in the stack or mow weighs from 4 to 5 pounds per cubic foot, and that hay baled under extreme pressure will weigh as much as 40 pounds per cubic foot, it is readily understood why baled hay is easier to store, handle, and transport, and why it feeds out with less waste than bulk or loose hay.

Modern hay balers have done much to preserve the quality of the hay and to speed the harvesting of this highly perishable crop. The automatic pickup baler (Fig. 169) cuts cost in both time and labor and makes baling hay a one-man job.

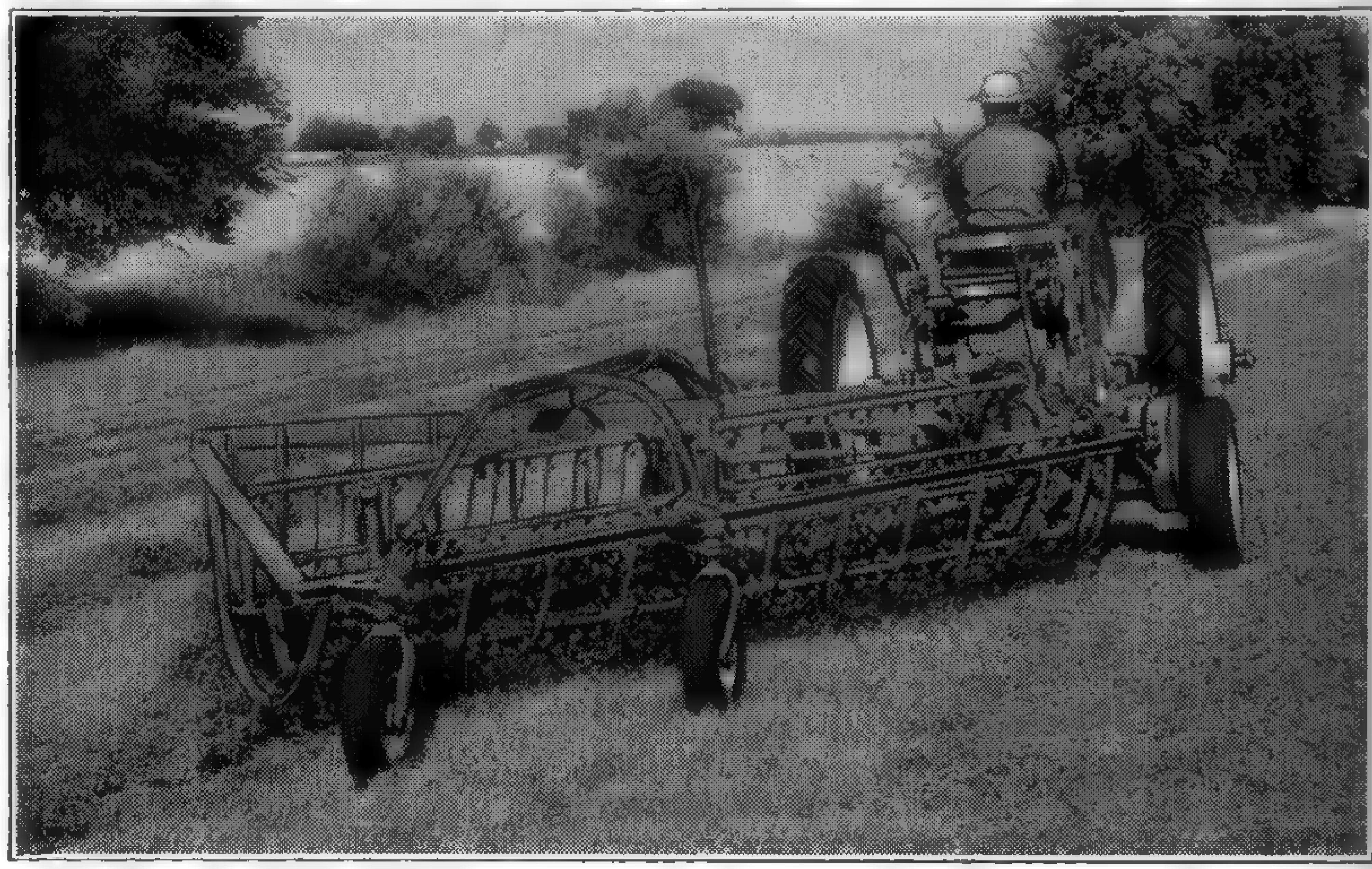


Figure 170—Low-wheel side-delivery rake.

The pickup forage harvester meets the requirements of the farmer who wants to chop his field-cured hay for economical storage in mow or stack, or to ensile his green hay crops for a succulent winter feed.

SIDE-DELIVERY RAKES

When the hay is cut, the flow of ground moisture is shut off, but the plant is full of water. The problem, then, is to reduce the moisture to a safe percentage for storing, and to do this in the shortest possible time.

The leaves, or tops, are left exposed to the sunlight, as they fall back over the mower cutter bar. If allowed to remain in this position very long, the leaves dry up and shatter. When this happens, the natural flow of moisture from stems to leaves is stopped and the moisture is "bottled up" in the stems. This results in unevenly-cured hay.

The function of the side-delivery rake (Figs. 170, 171, and 172) is to lift the hay from the swath and place it in a loose, fluffy windrow with the green leaves inside, protected from the sun's rays. The leaves, shaded by the stems, are cured rapidly by the free circulation of air through the windrow. They retain their fresh, green color and the stems are thoroughly cured for storing.

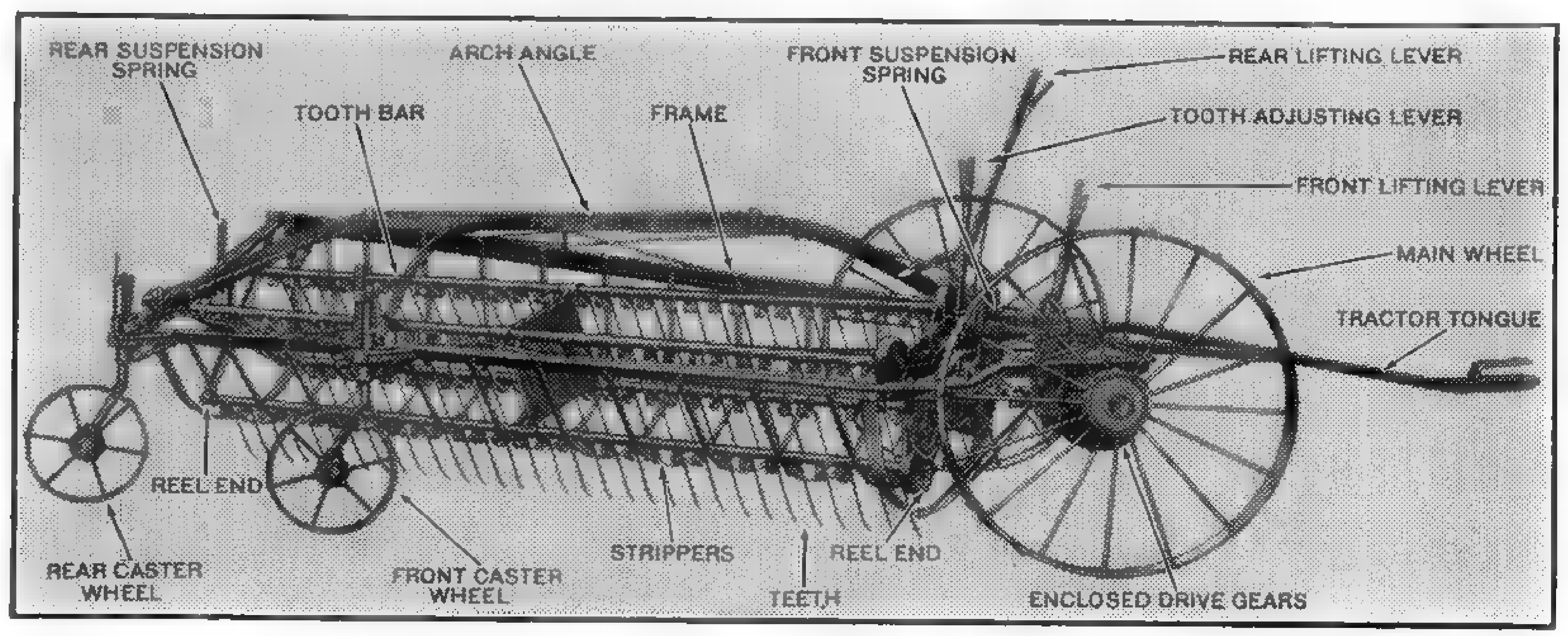


Figure 171—Side-delivery rake, showing principal parts.

If rainy weather catches the hay in the windrow, it is often necessary to turn it several times before it is thoroughly cured and ready for storing. When turning the windrow is advisable, the left-hand wheel is run next to the right-hand edge of the windrow. This operation inverts the windrow, placing it bottom-side up on dry stubble with the damp hay exposed for curing.

Field Operation. Side-delivery rakes, once they are adjusted to suit field conditions, are easy to operate. The operator simply drives the tractor and oils the rake when necessary.

The most important adjustment is setting the teeth in the proper position, or angle, in relation to the surface of the ground. This is done with the tooth-adjusting lever. The teeth should always be set as high as possible and still pick up all the hay. This setting causes the curved teeth to lift the hay gently, leaving the windrow as loose as possible and permitting free circulation of air.

In traveling on the road, the teeth should be angled so they are raised above the strippers out of danger of being bent by hidden obstructions.

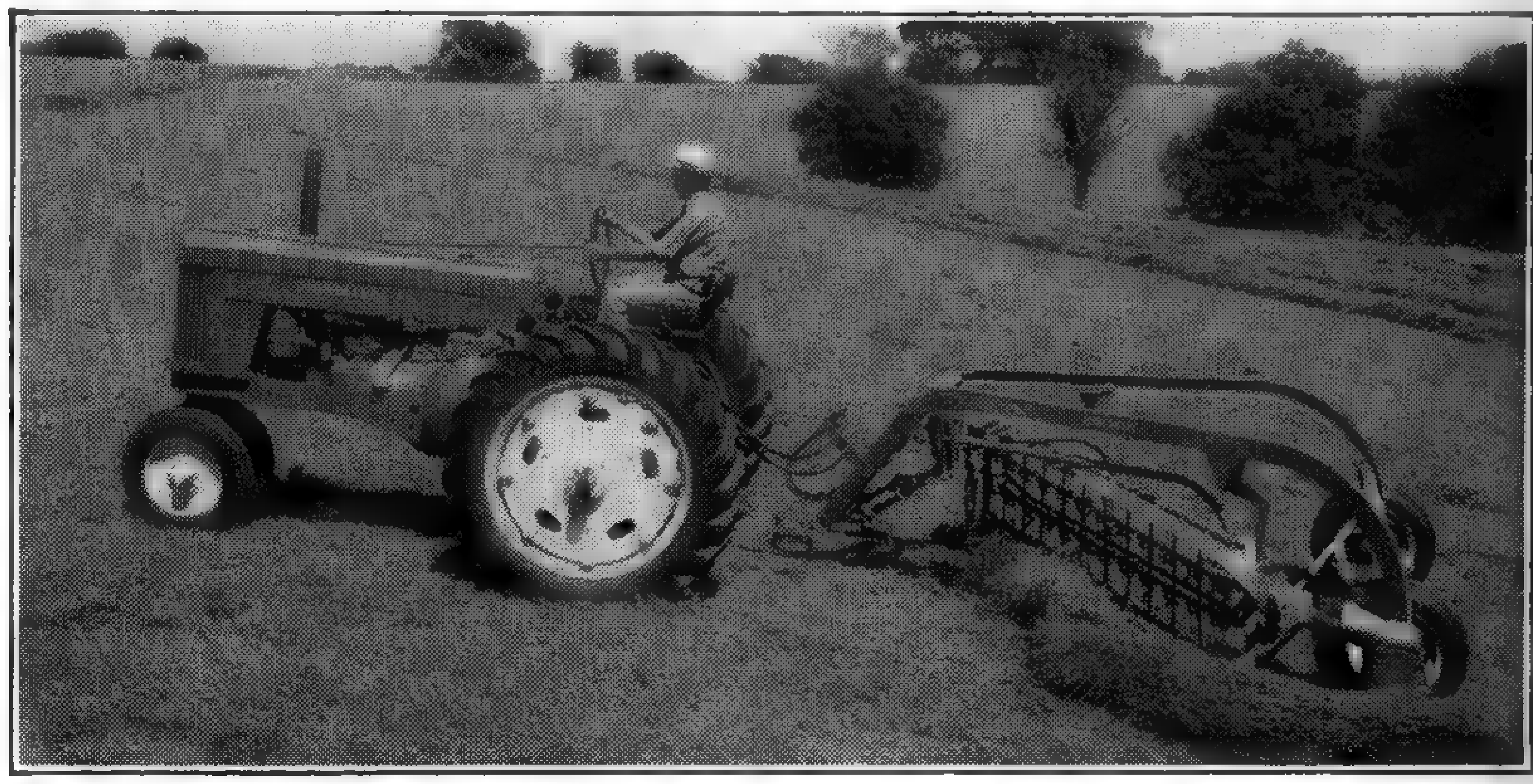


Figure 172—Semi-integral side-delivery rake.

The front lifting lever should be adjusted so that the front end of the reel is low enough to pick up the hay, but never so low that the teeth strike the ground.

In operation, the rear end of the reel should be slightly higher than the front end. This aids in making the windrow loose and fluffy.

Care Important. When starting a new side-delivery rake, or when using one that has been stored, it is a good plan to turn the reel by hand to be sure it revolves freely and that the teeth do not strike the stripper bars. Then throw the rake into gear and turn the wheel by hand to see that the tooth bars and gears work freely. Breakage of parts which result in serious delay can be avoided by taking these precautions before entering the field.

All wearing parts should be oiled regularly. An occasional thorough inspection for loose nuts, worn bolts, and other parts will add to the efficiency of the side-delivery rake.

SULKY RAKES

The sulky, or dump rake, is easy to operate and adjust, though many farmers work at a disadvantage when a slight adjustment would produce much better results.

The first requirement for good work is proper hitching. The rake shown in Fig. 173 is designed to work with the tongue 31 inches from the ground, measuring underneath at the front end. If this position is not maintained, the rake teeth will set at an improper angle, resulting in inferior work. If the tongue is too high, the teeth will have difficulty in clearing the hay after dumping; if too low, the teeth may fail to gather all the hay.

Adjustments. Slight pressure on a foot trip lever causes the dump rods to engage in the wheel ratchets resulting in dumping of the rake. After the rake teeth have cleared the hay and started downward, they may be forced down quicker and held in position on the ground by pressure on the foot

lever. An adjustment is provided at the hinge in this lever by which the wear can be taken up. If an adjustment is not made when the hinge becomes worn, the rake will be dumped with difficulty.

The height to which the teeth rise when the rake is dumped is controlled by adjusting a snubbing block bolt, located on the frame to the rear of the seat spring. If the rake rises too high and, consequently, does not get back to work as soon as it should, the block bolt must be screwed out of the block one or more turns. Turning the block bolt down permits the rake to rise higher when dumped.

If the rake repeats when it is dumped, the tension on trip spring is insufficient to hold the dump rod out of the wheel ratchets. More tension is produced by turning down the nut on the trip spring bolt.

When the wheel ratchets or dump rods become worn, the wheels and rods can be reversed, giving double wear.

Keep Nuts Tight. Because of the vibration attendant to raking, it is necessary that all nuts be kept tight. It is a good plan to go over the rake at regular intervals for this purpose.

Oil, used liberally on axles and wearing parts, will make for good work and lengthen the life of a dump rake.

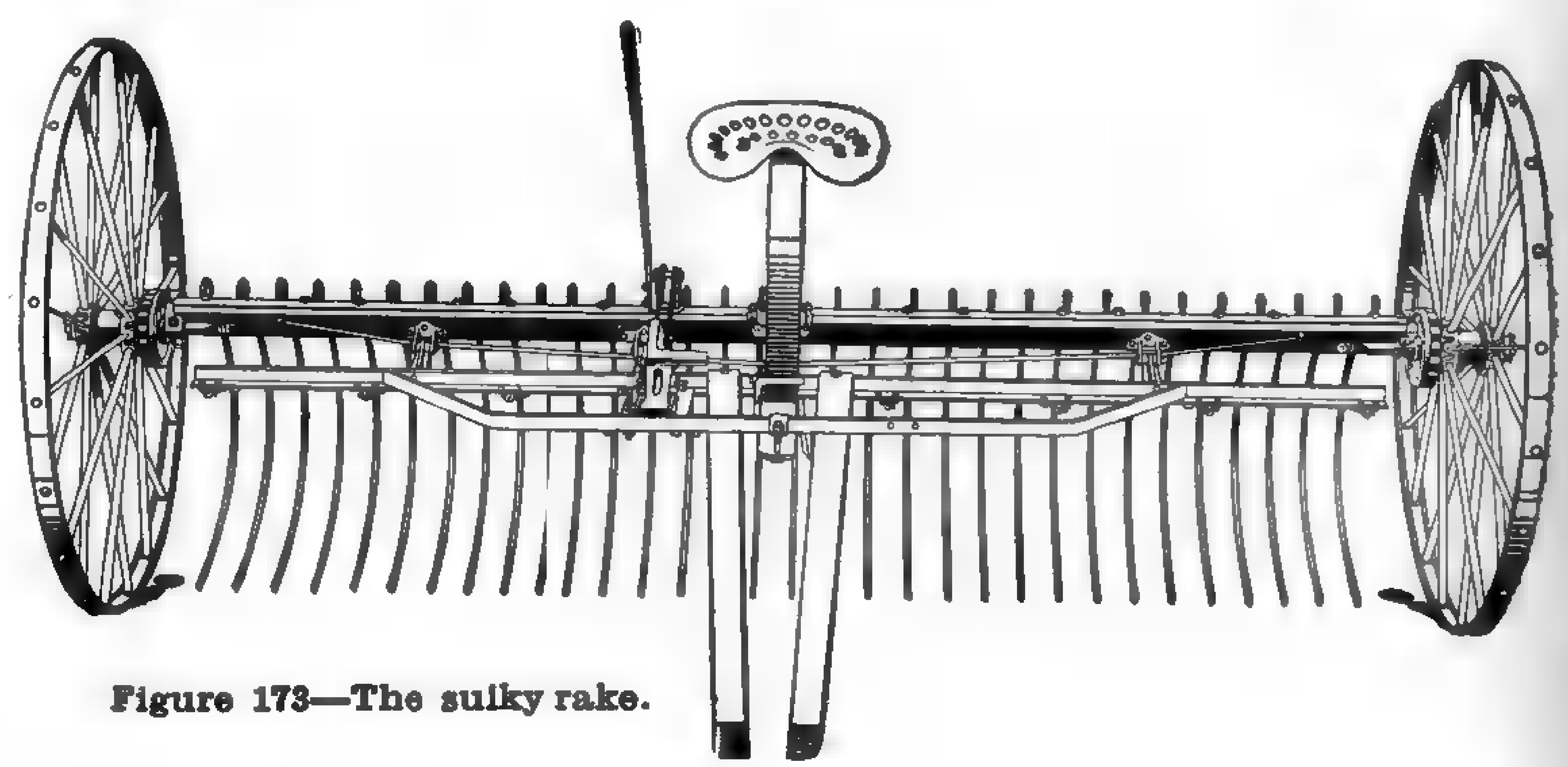


Figure 173—The sulky rake.

HAY BALERS

As mentioned previously, the modern automatic pickup baler has done much to reduce time and labor costs in harvesting the hay crop. The earlier windrow pickup presses, in common with the stationary or continuous type, were limited in their capacity by the speed and dexterity of the tying crew. By eliminating the slow and tedious job of hand tying, which required the services of two men, the pickup baler is a real time- and labor-saver in harvesting a perishable crop.

The baler shown is an automatic wire-tying, pickup baler operated by the power take-off of the tractor. In operation, the windrow is lifted by the pickup fingers, passed onto the feeders and into the transverse baling case, where it is compressed, in sliced charges, against pre-formed wire loops. Subsequent charges are added, until the bale reaches a weight of approximately 75 pounds, at which time the twisting mechanism is tripped and the tying cycle begins. Both ties are twisted, the twist is cut in the center, and the parts forming the completed bale are double kinked to prevent

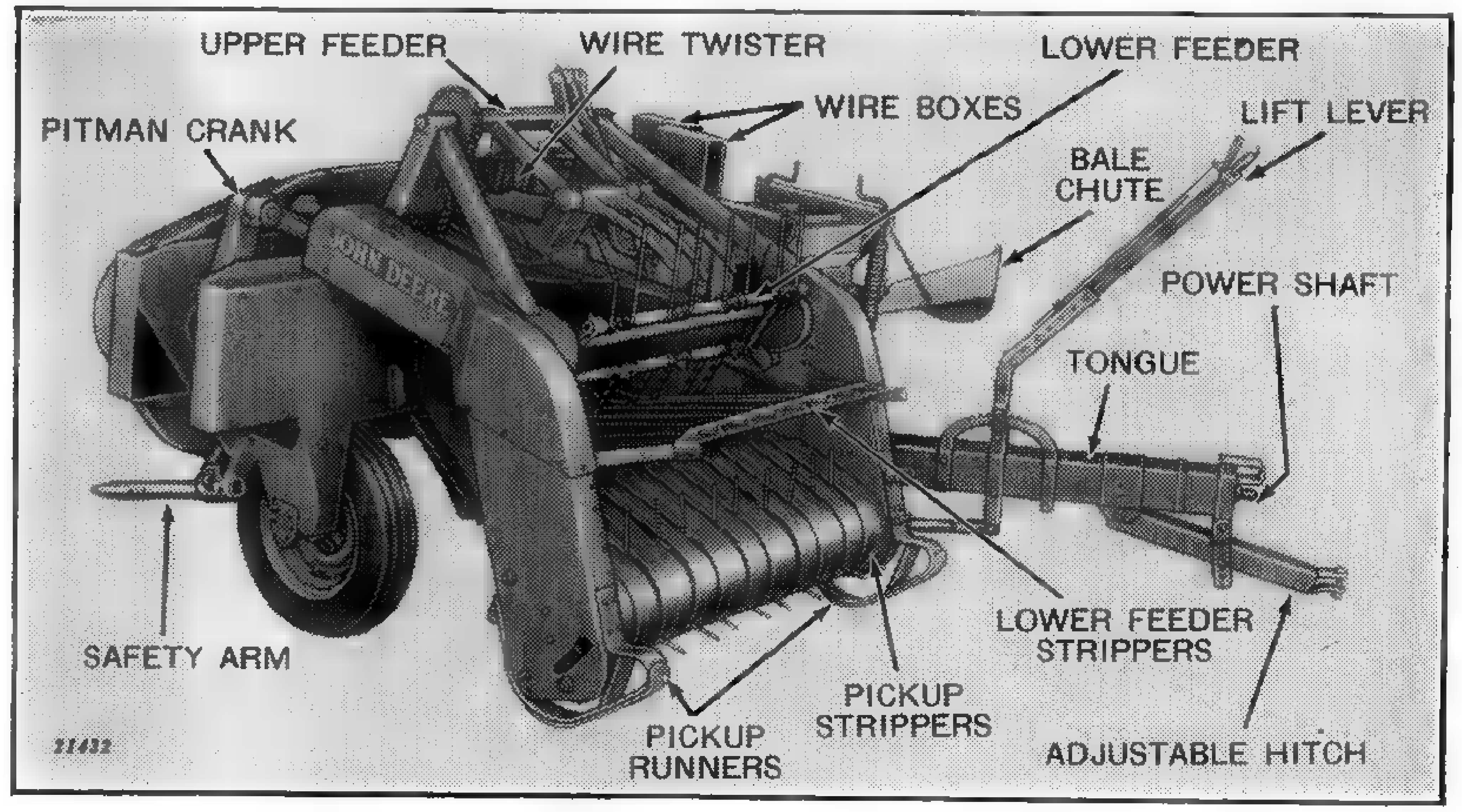


Figure 174—Important parts of the automatic baler are named above.

slippage. The remaining twists, also double kinked, form the loops for the following bale.

While the automatic baler does its work in a direct, comparatively simple manner, certain basic considerations must be observed. All hay should be windrowed with a side-delivery rake for uniform feeding to the baling case. Since proper timing of reciprocating parts is of great importance, it is well for the operator to familiarize himself with the function of all parts before attempting operation.

The operator's manual, which accompanies the new baler, should be followed carefully if the baler is to give the fullest service. Special attention should be given to proper lubrication of all parts.

FORAGE HARVESTER

The advent of modern forage harvester has changed the haying procedure on many farms.

Chopping hay in the field not only reduces labor of handling, but insures hay of higher feeding value since practi-

Figure 175—The field hay chopper at work in field-cured hay.

cally all the leaves—the real feeding value of the crop—are preserved.

Many farmers and dairymen have turned to green legume silage as a source of highly palatable winter stock feed. Most farmers who ensile these crops choose to use the first cutting which is the least desirable as field-cured hay and which is ready for cutting early in the season when the weather makes field curing uncertain. Most forage harvesters offer an adjustable length of cut—a long cut for field-cured hay, and a short cut for windrowed green silage crops. They also can be converted for harvesting ensilage row crops with the substitution of a row-crop unit for the windrow pickup (see page 196).

In operation (see Fig. 176), the forage harvester picks up the windrow, passes it on to the feed rolls which feed it into the cutting mechanism. In the harvester shown, four radial knives, working against a shear plate, cut the material into

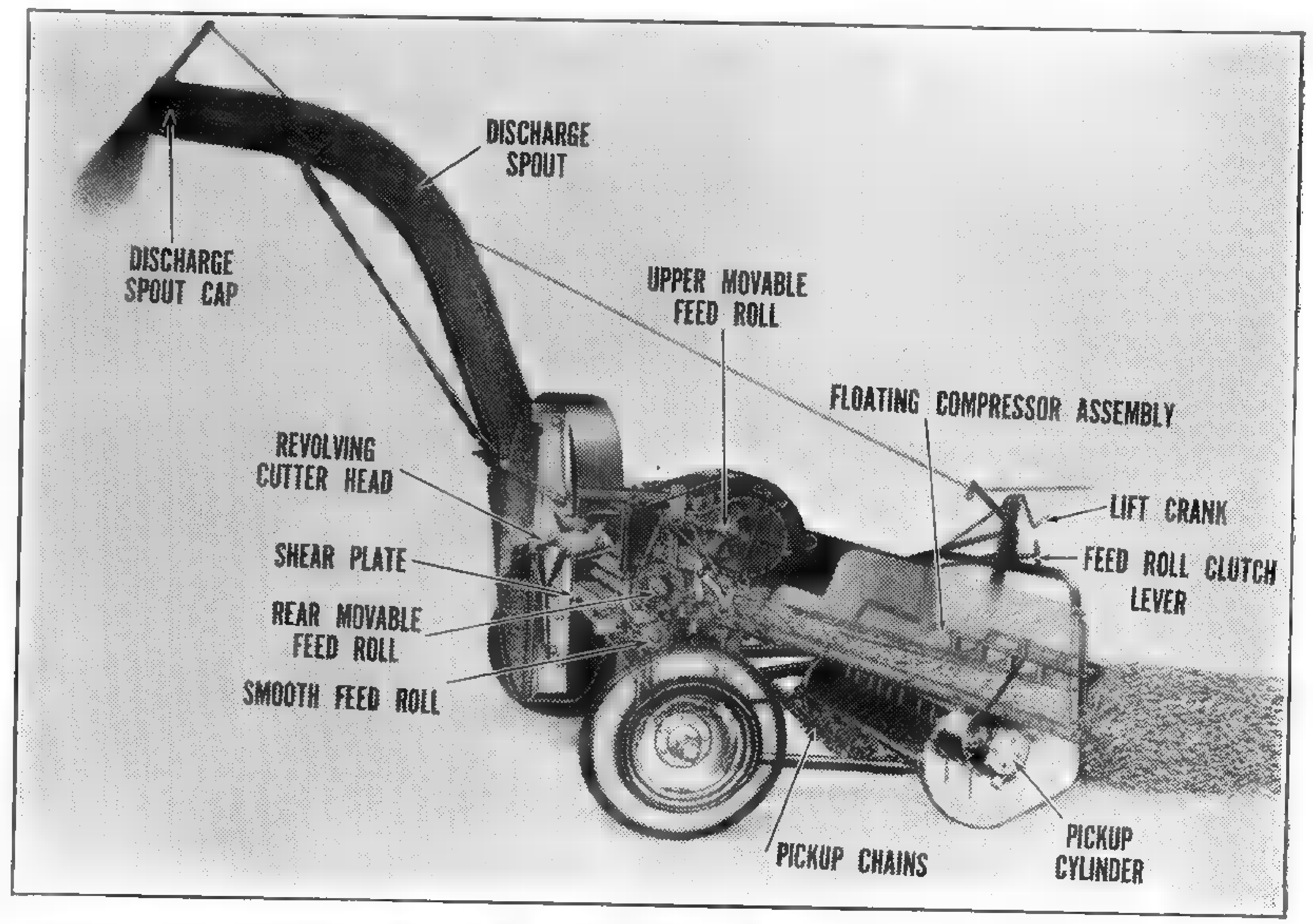


Figure 176—Phantom view of the pickup hay chopper showing progress of windrow through the machine; also principal parts.

proper length. Steel paddles, on the outer ends of the knife holders, throw and blow the cut material through the delivery spout to the wagon or truck.

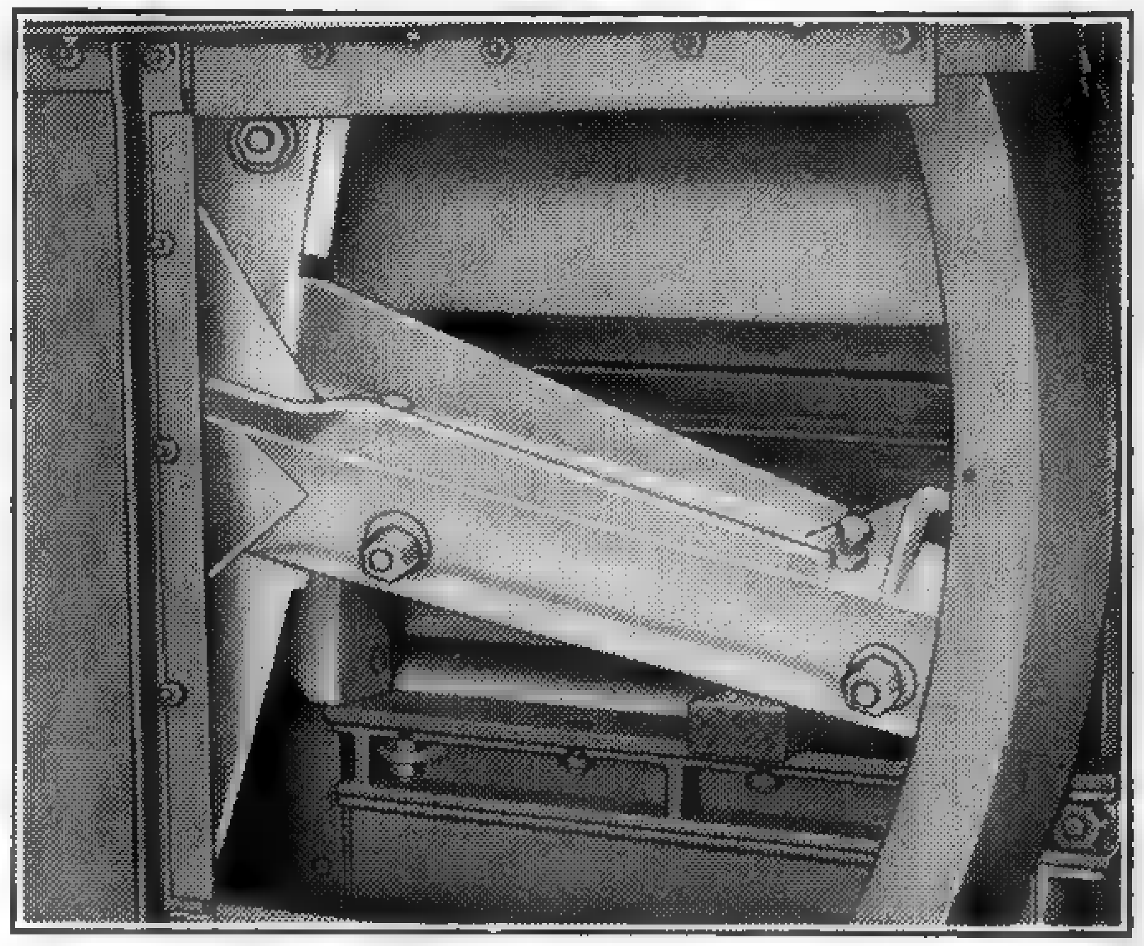


Figure 177—Inspection panel removed to show position and setting of radial knives and shear plate.

The adjustment and operation of the forage harvester are comparatively simple, yet certain fundamentals must be observed.

The floating pick-up unit should be set so that runners just touch the ground. The pickup unit set in this position is free to float over high spots in the field and do a good job of picking up the windrow.

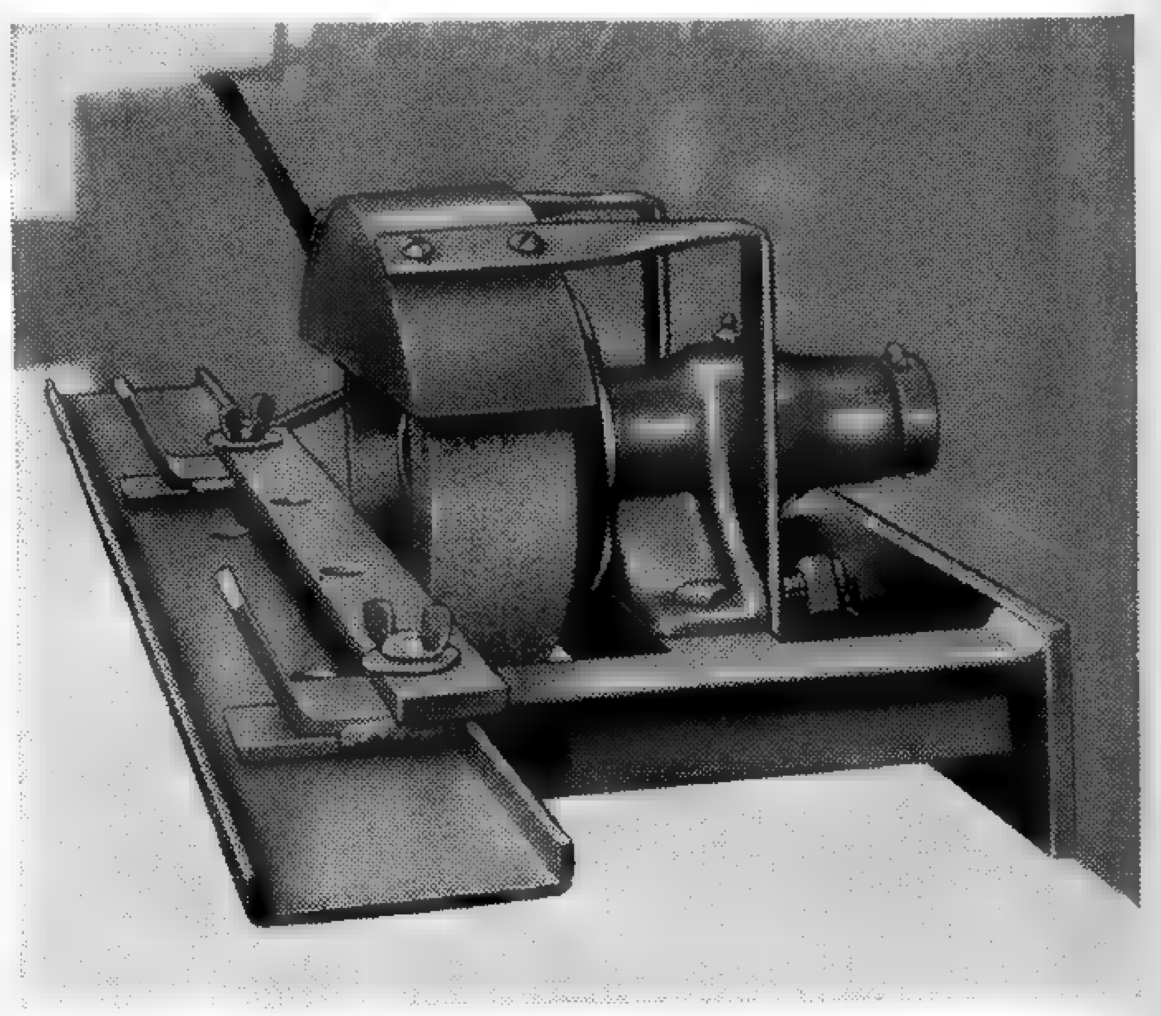


Figure 178—Sharpening the shear plate on the tractor-operated knife grinder.

The continued efficient operation of the forage harvester depends to a great degree upon the condition of the radial knives and shear plate. These should be inspected at regular intervals and sharpened when necessary. Alignment of these parts should be checked and compensating adjustments made. Special care should be taken to keep all nuts tight.

Thorough lubrication of all parts is especially important in high-speed equipment of this type.

Questions

1. *What qualities do you consider high-grade hay must have?*
2. *What legumes are grown in your community?*
3. *What is meant by "air curing" hay? Is this method used extensively in your community?*
4. *What is the function of the side-delivery rake?*
5. *How should the teeth of a side-delivery rake be set in relation to the ground surface?*
6. *What are the principal adjustments necessary on a dump rake?*
7. *What is the advantage of reversible wheels and dump rods?*
8. *What are the advantages of baling hay for feeding or for market?*
9. *What are the advantages of chopping hay?*
10. *Name the important points in servicing the forage harvester?*

Chapter XIII.

COMBINE HARVESTERS

The territory in which the combine harvester is used has spread from the rolling wheatfields of the Pacific Coast states to the fields of practically every section of the country. Each year finds this cost-reducing, labor-saving machine proving its value to farmers in new regions and in new crops heretofore thought impractical to combine. In recent years, the small combine, serving the individual farmer having comparatively small acreage, has made the harvesting of small grain and many seed crops a family affair. During the immediate post-war period the self-propelled combine proved its value as still a better means of harvesting large acreages having high yields with less man power and at still a further reduction of cost per bushel.

The combine, in many cases, effects a saving of from fifteen to twenty cents per bushel in harvesting costs. It

Figure 179—A small combine harvesting a fine crop.

displaces the binder, hand shocking, pitching, and threshing. In one operation, the grain is cut and threshed, the cleaned grain elevated into a storage tank, and the straw scattered on the field to be plowed under for humus.

Combines may be divided into two general classifications —pull-type (also called tractor-drawn) and self-propelled.

Pull-Type. The pull-type combine, as the name implies, is drawn by a tractor. The smaller combine, commonly referred to as a one-man machine, derives power for its operation from the power take-off shaft of the tractor, though an auxiliary engine can be furnished if desired. The larger combine has an auxiliary engine which operates the combine mechanism, leaving the weight of the machine the only load for the tractor to pull.

The size of the combine and its detail design is largely dependent upon the width of cut that the machine is expected to handle and the location of the platform or header in relation to the cylinder.

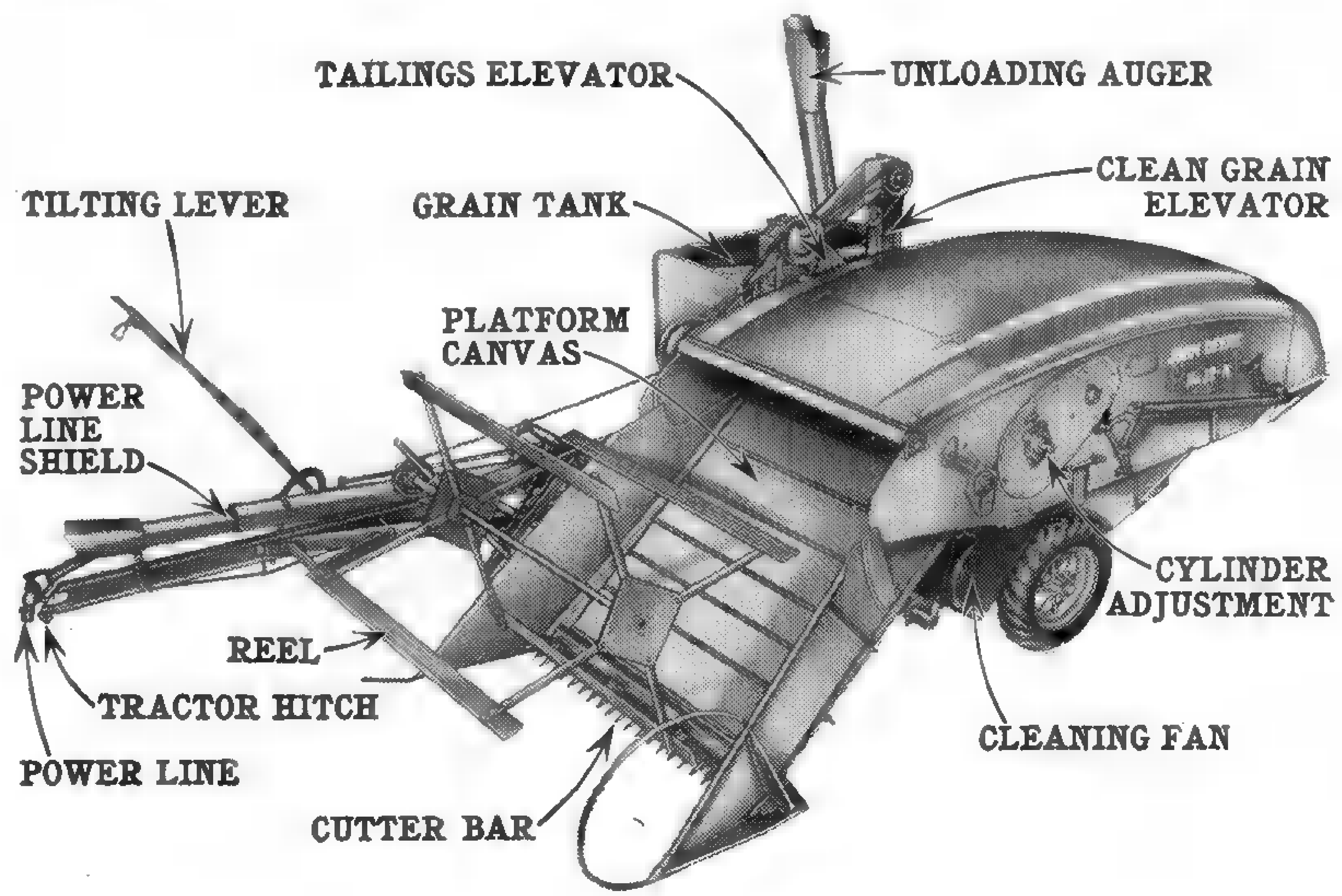


Figure 180—The one-man combine with principal parts indicated.

Straight-through, full-width design is limited to the small combine, usually having not more than a 6-foot cut. Straight-through means handling of the grain and straw in a straight line from cutter bar on through the machine—there are no turns. Full width means that the threshing and separating units are the same width as the cutter bar. A typical straight-through, full-width combine is illustrated in Figures 179 and 180.

Larger combines obviously cannot be made full width but usually employ straight-through design from the feeding unit on back. Because of the large cut the platform is usually to the right or left of the separator and, therefore, the cut grain must make a corner from the platform to the threshing unit. A combine of this type is illustrated in Figure 181.

The combine illustrated in Figure 181 is operated by only

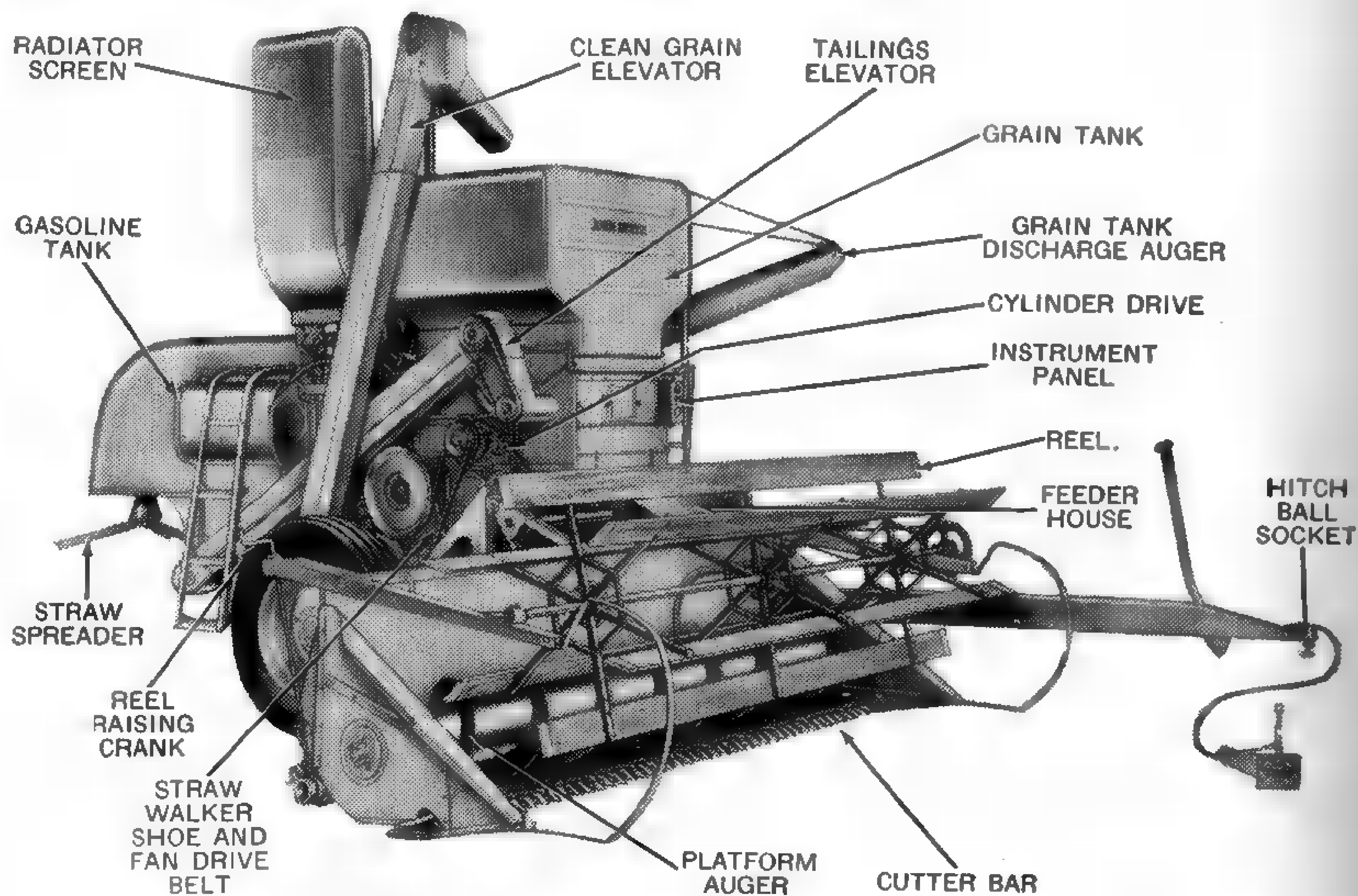


Figure 181—This 12-foot combine is operated by one man, the tractor operator.

one man even though it is a large combine having a 12-foot cut. All controls necessary for operating the combine are located within easy reach of the tractor operator. Formerly, combines of this size required at least two men—one on the combine and one driving the tractor. With this combine, one man and one or two additional men to haul the cleaned grain away are the combine crew. When contrasting the size of this crew with the crew required to operate binders and a stationary threshing outfit, it is apparent that a great saving in labor cost can be made with a combine.

Most combines are designed to operate over fairly level

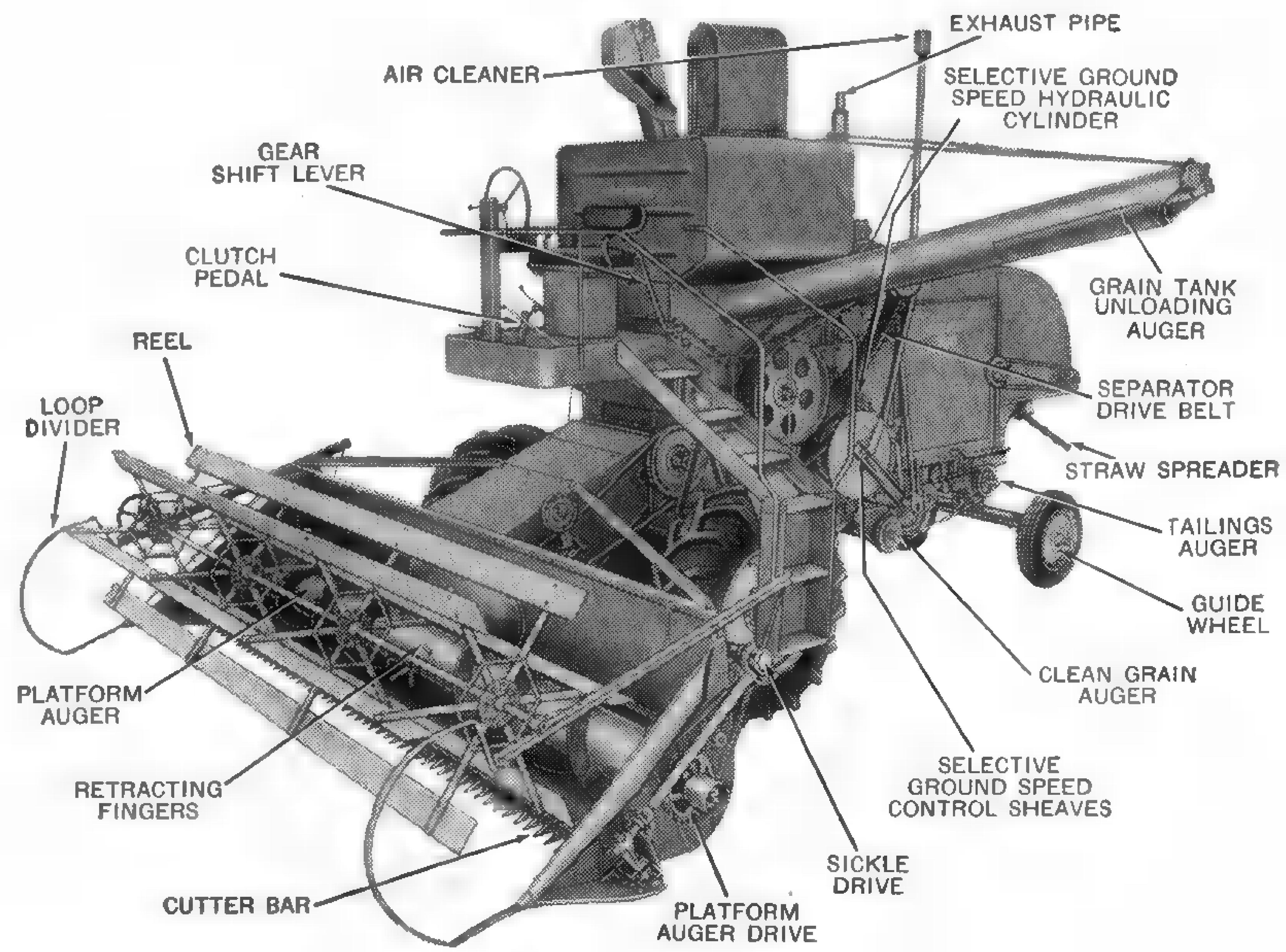


Figure 182—Some important units of the self-propelled combine [illegible] indicated in this view.

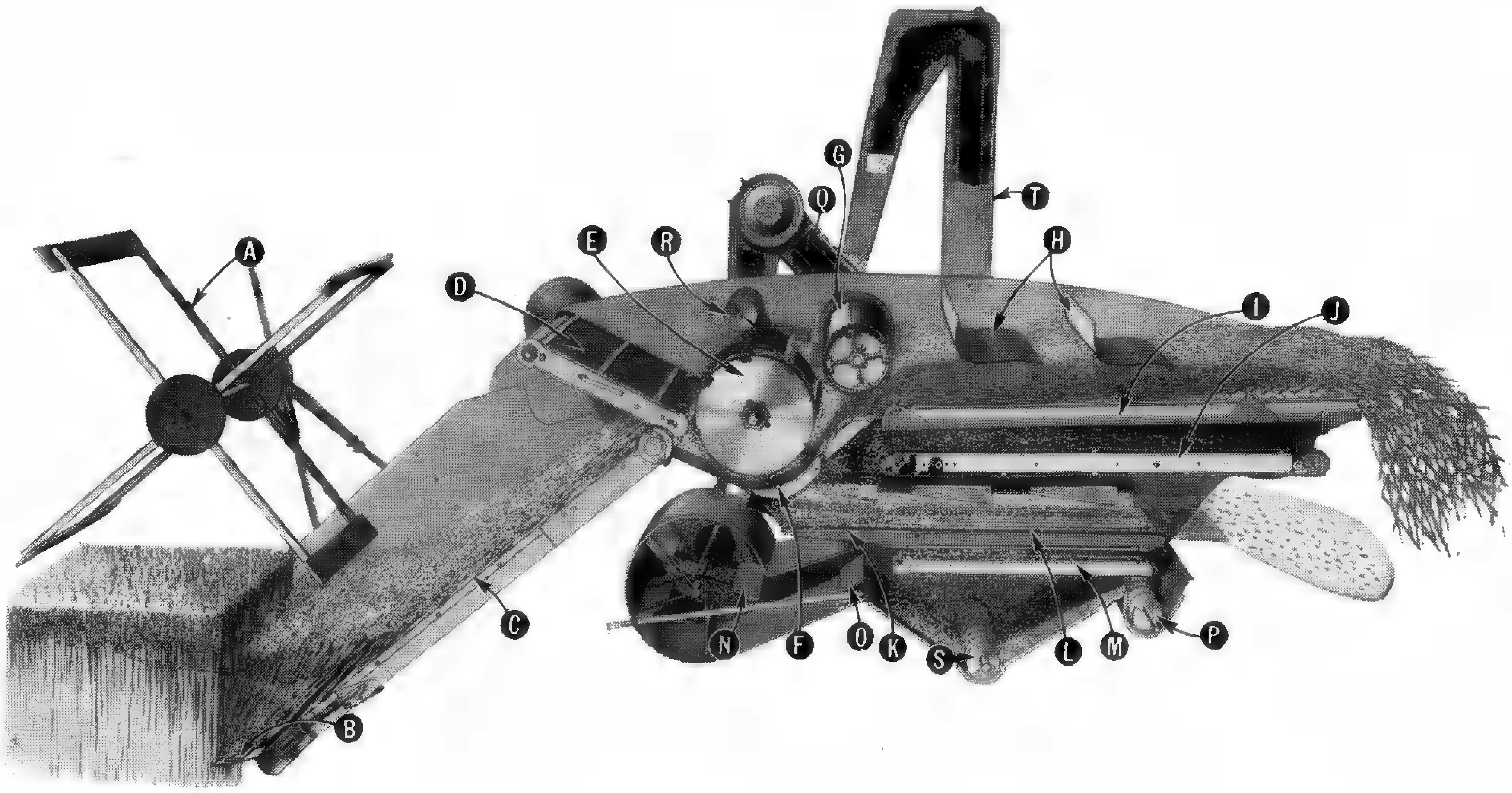


Figure 183—Cross-sectional view of straight-through combine showing how grain passes through the machine. See description below.

This cutaway view of the straight-through combine shows how the grain and straw are handled from the cutter bar straight through the machine.

The four-slat, ground-driven reel, "A," divides the grain and holds it to the cutter bar, "B." The cut grain is elevated by platform canvas, "C," which, together with feeder, "D," delivers grain in a thin, even stream to the rasp-bar cylinder, "E."

As the grain travels between cylinder, "E," and concave and perforated grate, "F," and back against beater, "G," behind cylinder, the greater part of separation takes place. The grain falls through perforated grate to shoe pan, "K," and is moved back to shoe chaffer, "L." Beater, "G," deflects grain down through the chaffer section at the front end of the straw rack, and passes the straw onto full-width straw rack, "I." During its outward movement, the remaining grain falls through cells in rack onto grain conveyor, "J," and is delivered back to shoe pan, "K," which moves it to front end of chaffer. Straw is then tossed out on the ground.

A blast of air from fan, "N," is directed by deflector, "O," against shoe chaffer, "L," and shoe sieve, "M." This blast, with the aid of chaffer and sieve agitation, blows chaff away and moves the tailings to tailings auger, "P." This auger carries them to tailings elevator, "Q," which conveys them to auger, "R," where they are delivered to the center of the cylinder for re-threshing.

Clean grain, after dropping through shoe chaffer, "L," and shoe sieve, "M," is carried by clean grain auger, "S," to elevator, "T," on opposite side of combine and elevated into grain tank.

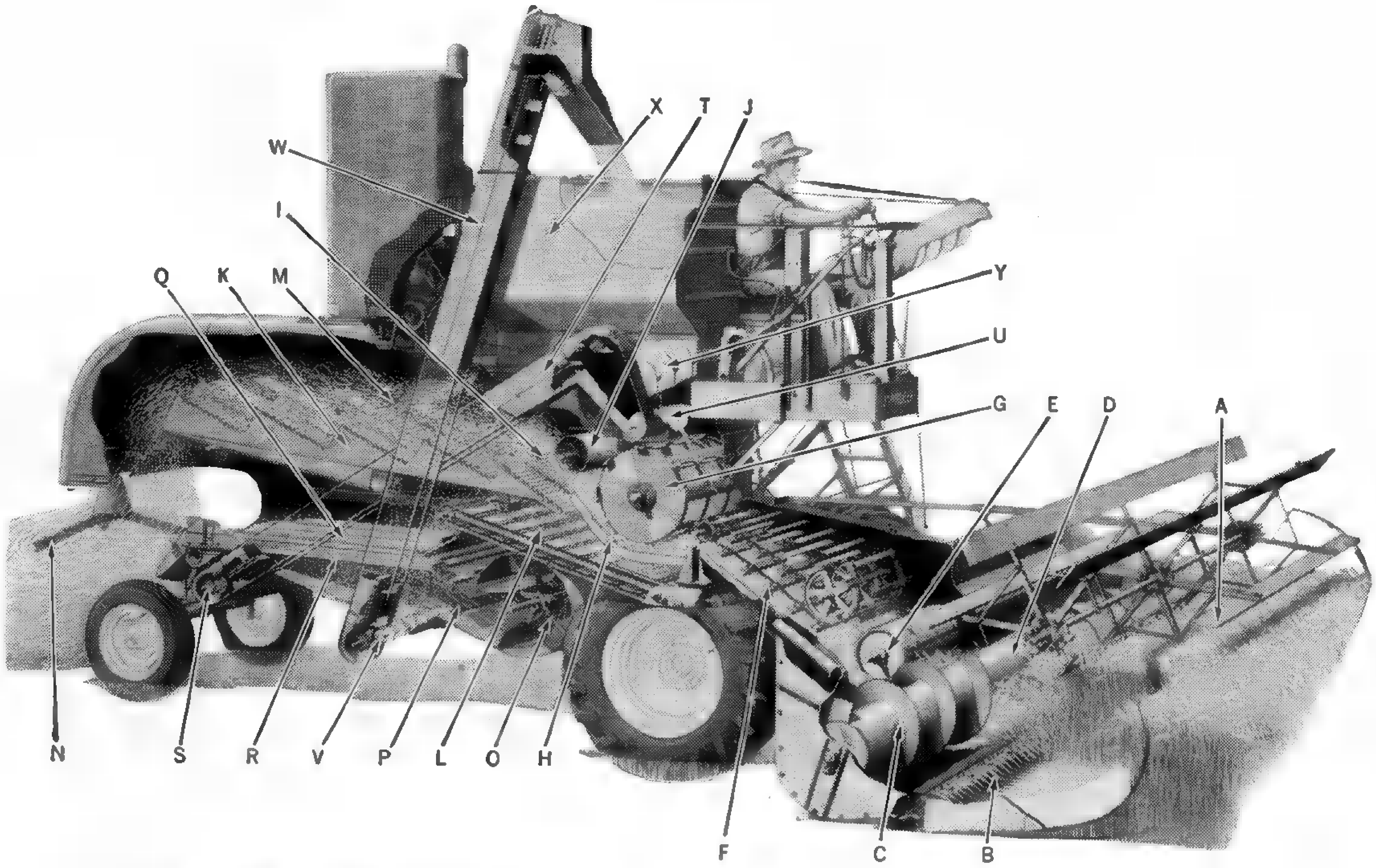


Figure 184—Cross-sectional view of a self-propelled combine showing the important parts. Explanation of the progress of the grain through the machine appears below.

This cut-away view of the modern self-propelled combine shows how the grain and straw are handled from the cutter bar on through the machine.

The power-driven reel, "A," divides the standing grain and holds it to the cutter bar, "B," until cut. The continuous auger, "C," carries the grain from both ends of the platform to the center of the auger, "D." Retracting fingers in beater, "D," take the material and feed it positively to feeder beater, "E," which, in turn, feeds it to the floating undershot feeder conveyor chain, "F." The feeder conveyor chain, "F," delivers the grain in a steady, positive stream to the extra-large, clean-threshing rasp-bar cylinder, "G."

As the grain travels between the cylinder, "G," and concave grate, "H," over grate fingers, "I," and back against the separating cylinder, "J," behind cylinder, the greater part of separation takes place. Separating cylinder, "J," strips straw from the cylinder, deflects grain through the grate fingers, "I," and passes the straw onto straw walkers, "K." Most of the grain falls through concave grate, "H," and fingers, "I," onto conveyor, "L," below cylinder.

Straw and remaining loose grain are passed along to straw walkers, "K." Curtain, "M," keeps grain from being thrown over. Straw is agitated by straw walkers, "K," on its outward movement, and the remaining grain falls through openings in walkers and flows back to shoe chaffer through grain return pans. Straw is then tossed onto spreader, "N."

The grain and chaff from conveyor, "L," are delivered to the cleaning shoe, "Q" and "R." A blast of air from undershot fan, "O," through adjustable windboards, "P," is directed against chaffer, "Q," and lower sieve, "R." This, with aid of sieve agitation, blows chaff away and moves tailings to tailings auger, "S." This auger carries them to tailings elevator, "T," which conveys them through cross auger, "U," to the center of the cylinder, "G," for re-threshing.

Clean grain, after dropping through chaffer, "Q," and sieve, "R," is carried by clean grain auger, "V," to elevator, "W," which delivers it to grain tank, "X." "Y" is grain tank unloading auger.

fields. Where grain is grown on hills or mountain sides as in the Pacific Northwest, a special hillside combine is used. The hillside combine shown in Figure 190 has a special leveling device to keep the separator level whether operating on uphill or downhill grades.

Self-Propelled. The self-propelled combine provides its own motive or propelling power as well as power for cutting, threshing, separating and cleaning the grain. The tractor is released for completing work on the farm; harvest fuel costs are cut about one-third. The self-propelled combine is one-man operated, and the operator, seated high on the machine, has a clear, direct view of his work with all controls conveniently located for easy adaptability to changing field conditions. In fundamental design, it is of the "straight-through" type with the cut grain being delivered to the center of the platform and then up into the threshing unit. No grain is run down when opening fields and the operator may start combining anywhere leaving green spots in the field until later.

Some self-propelled combines as the one illustrated in Figure 182, permit working at any combining speed from a mere crawl on up. This accurately adapts the speed of travel to the capacity of the machine. Increasing or decreasing speed within the three forward transmission gear ranges is accomplished without stopping to shift gears.

The self-propelled combine is especially adapted to the grain harvest on large acreages of the Great Plains and, with special equipment, to meet conditions as they exist in the rice harvest. It is being universally accepted in all sections of the country and in all combineable crops where harvest time is at a minimum and where there is sufficient acreage to warrant a self-propelled combine. The 12-foot self-propelled combine can easily harvest 40 to 50 acres a day.

The small combine shown in Figure 180, is largely designed for the small or medium-sized farm where diversified farming is practiced. It has been used successfully in harvesting

many different crops, including soybeans, in addition to all small grains and many seed crops. With this machine, the farmer with an average acreage of small grains can handle his harvest at lowest possible costs.

Principle of Operation. The combine performs four major operations—it cuts the grain, threshes or beats the kernels from the heads, separates the kernels from the straw, and cleans the grain, removing dirt and chaff before the grain is elevated into the storage tank.

The cutting unit which consists of the cutter bar, reel, platform, and feed mechanism operates in much the same manner as a binder, with the exception that it usually cuts higher taking only as much straw as necessary to get all the heads and delivers the heads and the straw into the threshing unit. Manual, hydraulic, or electric lifting mechanisms are used for raising or lowering the platform to meet varying crop conditions. Adjustment and speed of reel are very important in getting the grain into the platform without loss.

The rubbing or flailing action of the cylinder and concave grate in the threshing unit loosens the grain from the heads. Correct cylinder speed and cylinder and concave clearance are all important for good threshing and vary according to the crop. Cylinder speed should be as low as possible and cylinder and concave clearance as high as possible for thorough threshing without excessive cracking of grain.

The separating unit agitates the straw after it comes from the threshing unit, shaking out the loose grain and delivering it to the cleaning unit. Most modern combines separate up to 90% of the grain at the threshing unit, preventing remixing of the grain with straw, thereby making separation of the remaining loose grain comparatively easy. Usually, a separating cylinder or winged beater is placed directly behind the threshing cylinder to slow down the speed of the straw as it comes a mile a minute from the threshing unit. This allows the straw agitating unit to do a thorough job of separating.

Thorough cleaning plays an important part as to the price the farmer gets for his grain. The cleaning unit, consisting of a fan and the shoe containing the cleaning sieves, must remove all foreign material in the grain. The fan blast together with the shaking action of the shoe should keep the chaff lifted slightly off the sieves moving it to the rear and out of machine. Effective cleaning requires the intelligent use of a number of adjustments built into the cleaning unit. Unthreshed heads, commonly called tailings, which pass over the sieves are returned to threshing unit for rethreshing.

Windrowing Method. In many conditions, it is desirable to cut the grain with a windrower and thresh it later with the regular combine equipped with pickup attachment. When there are many weeds in the grain, when there is considerable moisture at harvest time, or when the crop ripens unevenly, this method of combine harvesting is used to advantage.

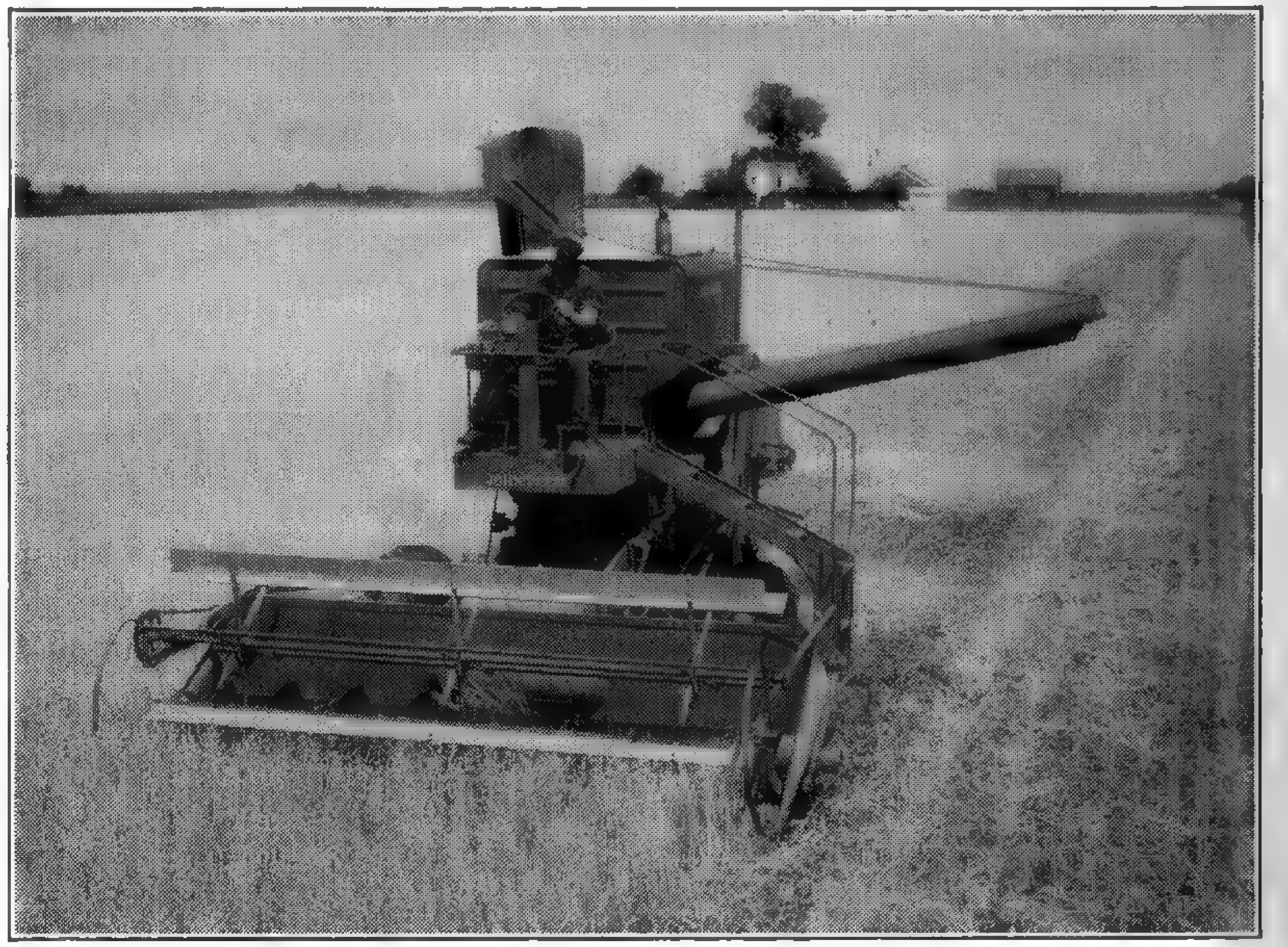


Figure 185—Harvesting [redacted] fine crop of wheat with the self-propelled combine.

The windrower, shown in Fig. 187, consists of the usual cutting-unit platform, sickle, canvases, and reel. These parts are driven either by a power drive shaft from the tractor or through a ground drive. An opening at the inner end of the platform permits the cut grain to be laid on the stubble in windrow form.

When the grain is properly cured or when the moisture content is sufficiently low, a special windrow pickup platform is attached to the combine, or the pickup unit is attached to the regular combine platform. Its function is to elevate the grain onto the combine platform and, from this point on, the threshing, separating, and cleaning processes are the same as described for the regular combine. Pickup attachments are illustrated in Figs. 188 and 189.

The windrow method of combine harvesting has extended the boundaries within which the combine may be used. Many sections where weeds or rainfall have delayed the introduction of the combine are now using the windrow

Figure 186—Here the self-propelled combine [redacted] at work in conditions typical of the rice harvest.

method with remarkable success.

Operation and Care. All details of the operation, care, and repair of combines will not be given in this text because the actual servicing of combines will vary widely with the type and manufacturer's design. It is wise, therefore, to follow carefully the operating instructions furnished by manufacturers with the machines they sell. The operator should familiarize himself with these servicing and operating instructions so that he can operate his equipment with greatest efficiency.

Certain essentials for successful operation are stressed by all manufacturers, however, and some of these are mentioned here.

The maximum saving of grain and the quality of work done in all conditions depend very largely upon the operator's making the best use of the adjustments provided for varying conditions. The grain in the tank, the tailings, the straw coming over the straw walkers or racks, and the material going over the shoe reveal the quality of work being done and indicate what adjustments are necessary.

The tractor or combine operator should vary the travel

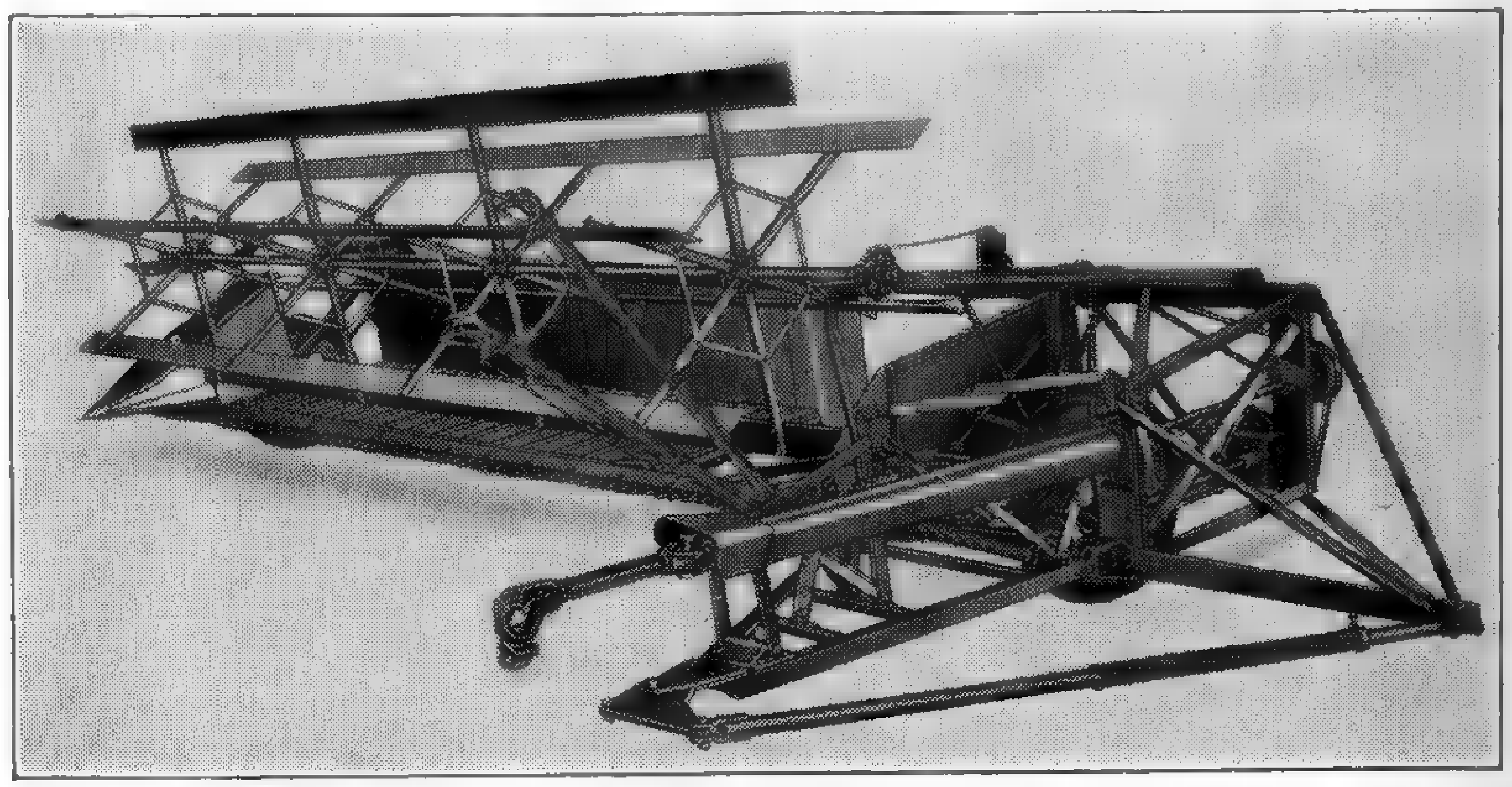


Figure 187—Windrower used for cutting and windrowing the grain; grain is later picked up with the pickup attachment used on a regular combine, and threshed.

speed to meet conditions. As he approaches a very heavy, down, or tangled condition, he should slow down to give the combine a chance to do a thorough, clean job of separating. In some conditions, it may be advisable to cut less than a full swath, giving the combine every opportunity to do good work. By listening constantly to the sound of the engine, the tractor operator can tell approximately how fast he should travel.

The combine operator should not only adjust his machine to hold threshing losses to a minimum, but he should also adjust and operate the platform and reel to reduce cutting losses. He should watch for stones and other foreign material that the platform may gather, and stop his machine before such obstructions reach the cylinder and cause damage.

Safety first should always be the rule when working around a combine. Never attempt to make repairs while the machine is running. Be careful when working around belts and chains. The great majority of accidents around combines results from carelessness.

Proper lubrication is of first importance. The large number of bearings in a combine necessitate careful attention to regular and thorough oiling. The combines shown are provided

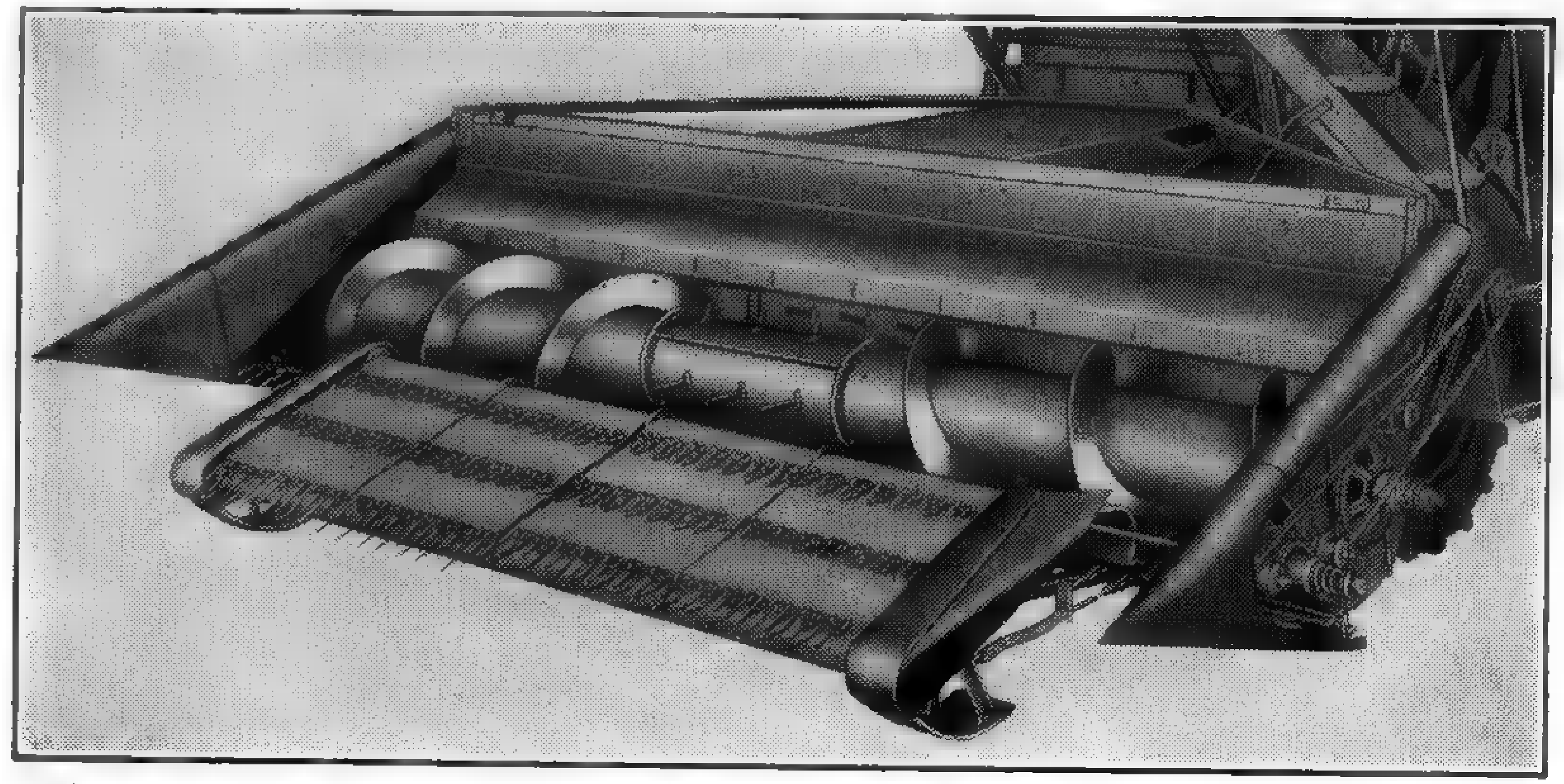


Figure 188—Pickup attachment for combine attached to the short pickup platform. The windrowed grain is elevated onto the platform which carries it into the combine in the regular way.

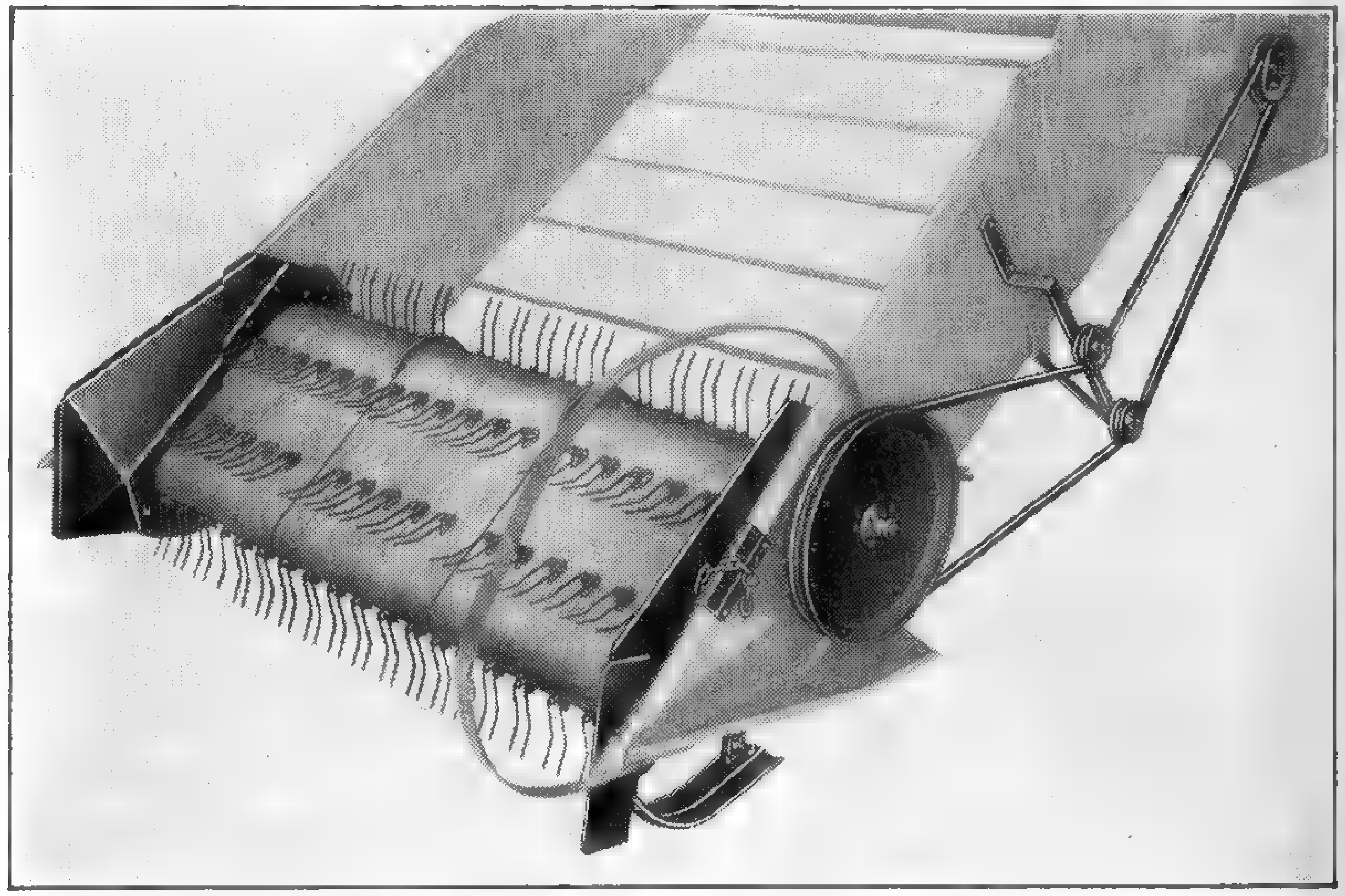


Figure 189—Pickup attachment shown in place on a one-man straight-through combine.

with a high-pressure grease-gun lubrication system which greatly facilitates proper lubrication.

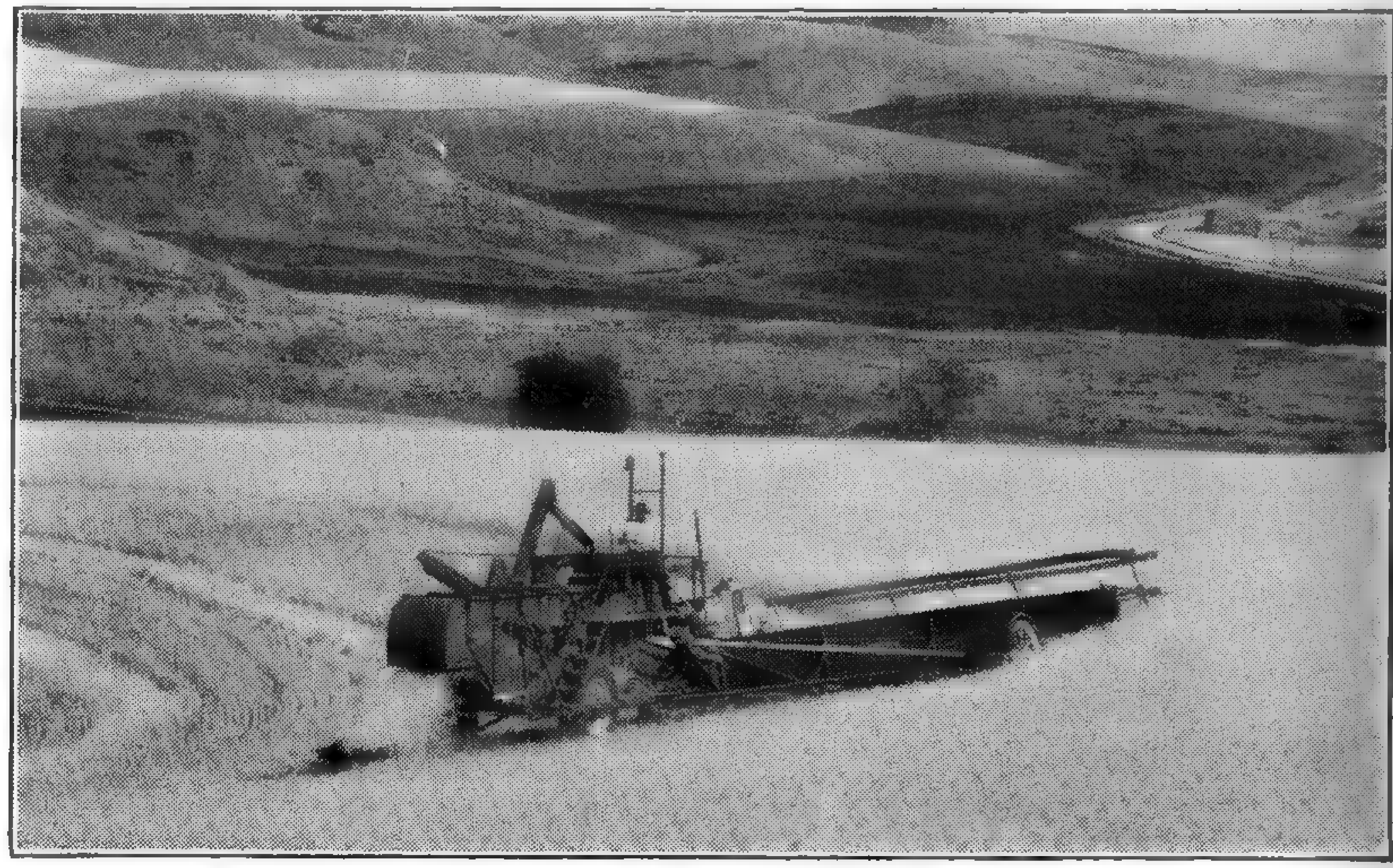


Figure 190—A hillside combine at work in the far western wheat territory.

The upkeep expense on a combine will be greatly reduced if all bolts are kept tight, and belts, canvases, and chains operated at correct tension. Regular inspection of the entire machine will save delays and reduce operating costs to a minimum.

At the end of each season it is important that all dust and chaff be cleaned from the inside and outside of the machine. If not removed, such material will gather moisture and cause steel parts to rust and wood to swell or rot. It will pay the owner of a combine to overhaul and clean the machine thoroughly at the close of each season.

Questions

1. *Name two general types of combines.*
2. *Describe the principle of the combine.*
3. *What are its advantages over other methods of harvesting small grains?*
4. *What are some of the important points to remember in operating a combine? In storing it?*
5. *Describe the windrow method of combining and the machines used.*
6. *How may the tractor operator aid in doing a clean job of harvesting?*
7. *Why is "Safety First" a good motto for combine operators?*

Figure 191—An auxiliary engine furnishes power for operating the small combine shown here.

Chapter XV.

ENSILAGE HARVESTERS

Where row crops are to be cut for ensilage, the field ensilage harvester solves the problem with the minimum of work, at extremely low cost, and enables the silo owner to harvest the crop at just the right time to make high-grade ensilage. The harvester shown below is the forage harvester, described on pages 175 to 179, with the row-crop unit installed in place of the windrow pickup unit.

In principle, the field ensilage harvester embodies two separate units. The power-driven harvesting unit consists of the gathering and cutting parts, somewhat similar in design to corresponding parts used on the corn binder, in combination with a cutting unit designed to cut the corn into lengths suitable for ensilage. A second unit, the blower, is stationed at the silo; its function is to blow the ensilage into the silo.

In operation, the cutting and gathering parts of the

Figure 192—From standing corn to top-grade ensilage in one operation.

harvester unit cut the corn and deliver it to the feed rolls which pass it on to the cutting unit. Here, the revolving cutterhead, driven by the tractor engine through the power shaft, cuts the crop into suitable lengths, and passes the freshly-cut ensilage through the curved delivery spout directly into a wagon drawn behind the harvester or into a truck driven at the side.

The blower unit, stationed at the silo, finishes the job by elevating the ensilage into the silo. (See Fig. 194.)

The details of operating and adjusting the feeding, cutting, and elevating parts of the field harvester are so similar to those given in the chapter on the forage harvester, that a further discussion of them is not necessary. Most important in caring for the cutting unit, which runs at high speed, is providing sufficient lubrication to all parts and keeping all

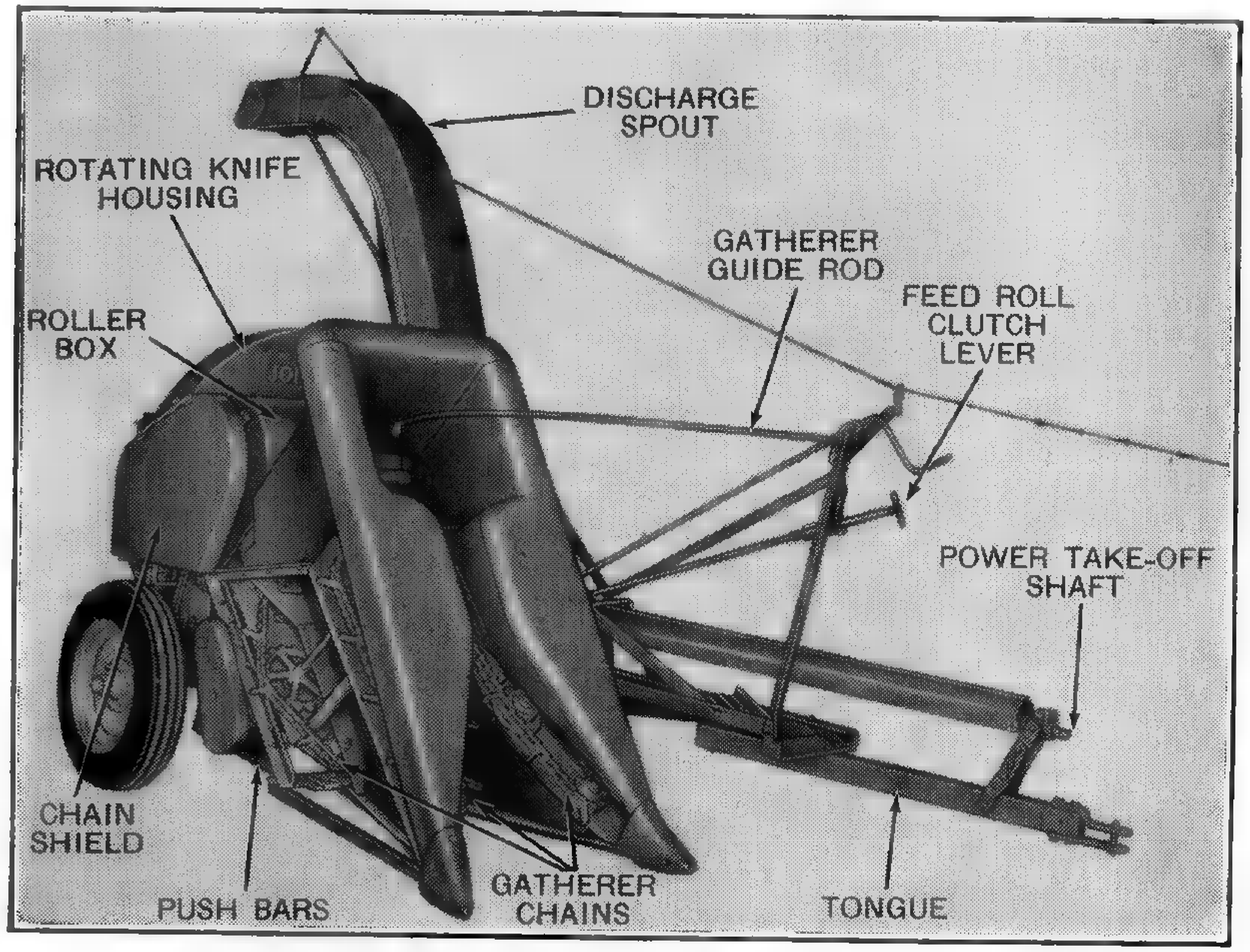


Figure 193—The harvesting unit of the ensilage harvester with important parts indicated.

bearings tight and knives in good repair. Servicing the knives and shear plate of the ensilage harvester shown follows the same procedure given for the forage harvester.

The blower, like the cutting unit of the harvester, should be kept thoroughly lubricated to insure efficient operation and long life. As is the case with all modern equipment, special attention should be given to proper adjustment and lubrication of all parts, and to keeping all nuts tight.

When the season's work is done, both units should be cleaned thoroughly and inspected for worn parts which should be replaced with new parts during the slack season.

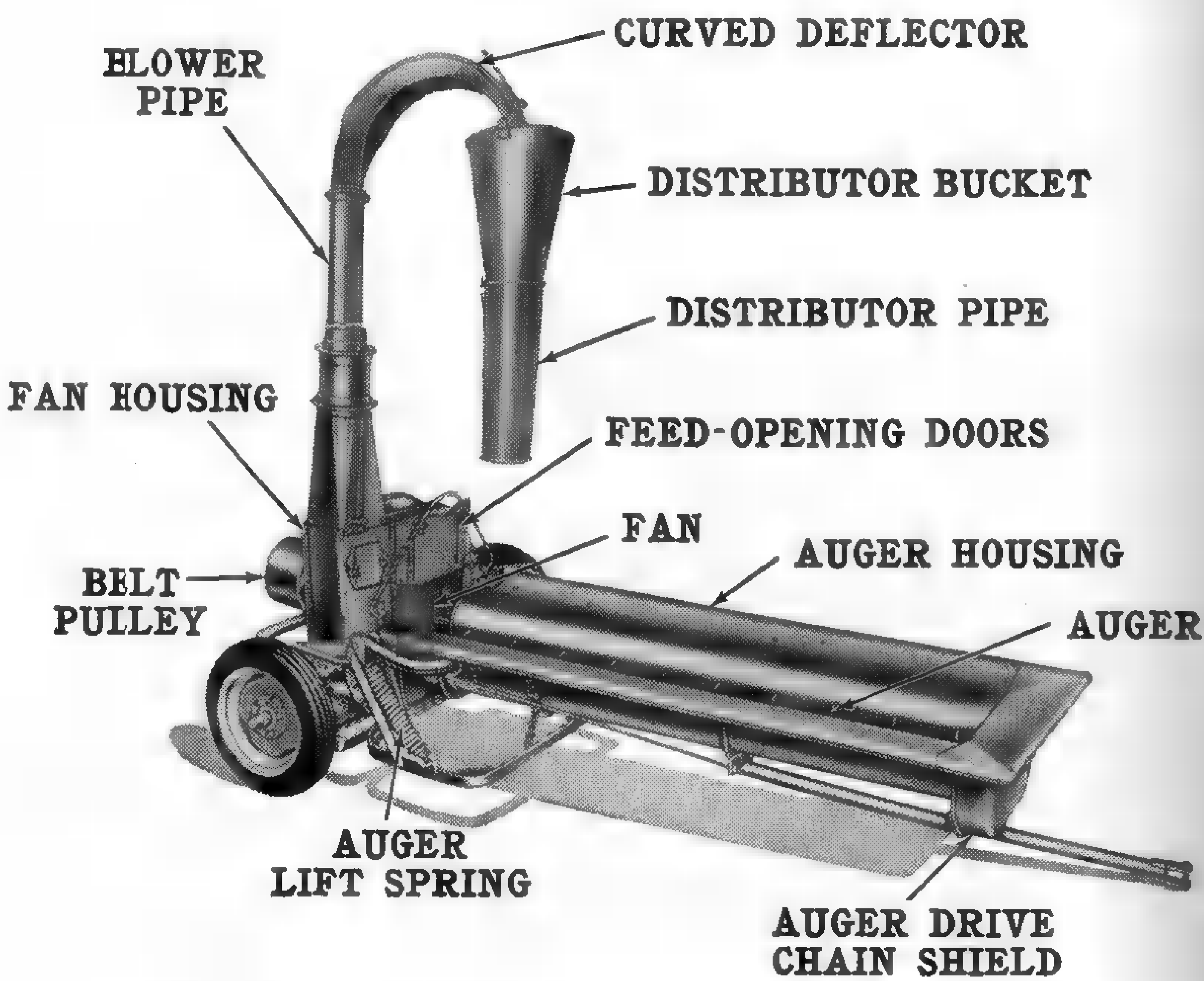


Figure 194—The blower unit is stationed [illegible] the silo to handle the ensilage from wagon to silo.

Questions

1. *What are the advantages of using the field ensilage harvester?*
2. *Describe the main parts of the harvester unit and mention their purpose.*
3. *How is the cutting unit driven?*
4. *How are knives sharpened and adjusted?*
5. *What is the function of the blower?*

Figure 195—The forage blower is a time- and work-saver in storing ensilage.

Chapter XVI.
CORN PICKERS

Wherever corn is husked, either for the market or for feeding purposes, the corn picker is more generally used each year. The hard work of husking by hand is fast being replaced by the easier, faster, and less expensive mechanical method.

The corn picker has been refined and simplified, mechanically, to a point where its operation is not difficult. With the aid of the manufacturer's operator's manual, furnished with each new machine, the average farmer finds the corn picker comparatively easy to operate.

When mechanical corn pickers were first introduced, the one-row, horse-drawn, ground-driven type was the only type manufactured. With the advent of tractors and power farming came the power-driven one-row and, later, the power-driven two-row pickers (Fig. 197), which have greatly increased the corn-picking capacity of one man. With a power-

Figure 196—The mechanical picker reduces cost of harvesting corn.

driven picker, equipped with wagon hitch, one man has control of tractor, picker, and wagon.

The push-type or mounted-type picker, such as illustrated in Fig. 196, which, when attached to the tractor makes up a compact, easily-handled one-man picking outfit. It was a natural development following the advent of the general-purpose tractor and the general trend to integral or tractor-mounted equipment. Its advantages lie in the fact that no hand picking is necessary in opening fields, that the corn is handled in a direct line from the snapping rolls to the wagon elevator, and that, with gatherers in front of the tractor, the operator has a good view of the work at all times. With its rear delivery, a direct center hitch is provided for the wagon, thereby eliminating side draft. In addition, the mounted picker is easily transported from field to field, since its control is just as easy as driving the tractor.

Comparatively new in picker design is the wheel-and-drawbar mounted type (Figs. 198 and 199), especially

Figure 197—The power-driven, two-row picker speeds up the work of harvesting.

adapted to the smaller tractors. In this type of picker, weight is distributed between tractor drawbar and wheel of the picker. Its advantages lie in its simplicity and ease of attaching and detaching.

How They Work. The function of corn pickers is to snap the ears from stalks, remove husks and silks, and deliver the cleaned ears into a wagon. To do this, three main units are required—the snapping, husking, and elevating units. Efficiency of the picker depends to a great extent upon the correct adjustment of the snapping and husking units.

Figure 198—The wheel-and-drawbar-mounted picker at work in the field.

Power to operate the corn picker is furnished direct from the tractor engine through a power drive shaft. Thus, the tractor engine, running at steady speed, insures uniform power for operating snapping, husking, and elevating units.

The principle of operation of one-row and two-row pickers is so similar that both will be covered in the following text.

Snapping Unit. As the cornstalks advance between the gatherers, they are drawn into the snapping rolls with the aid of gathering chains, one on the inner and two on the outer gatherers. The stalks pass between the rolls while the ears are snapped off and carried to the husking unit. Snapping rolls are illustrated in Fig. 201.

The snapping rolls are adjusted according to the condition of the corn; if damp, rolls are run close together, but not touching; if dry, the rolls are set to run farther apart. They should never be run closer together than necessary for good work —to do so increases the draft. The desired setting is secured by an adjustment provided.

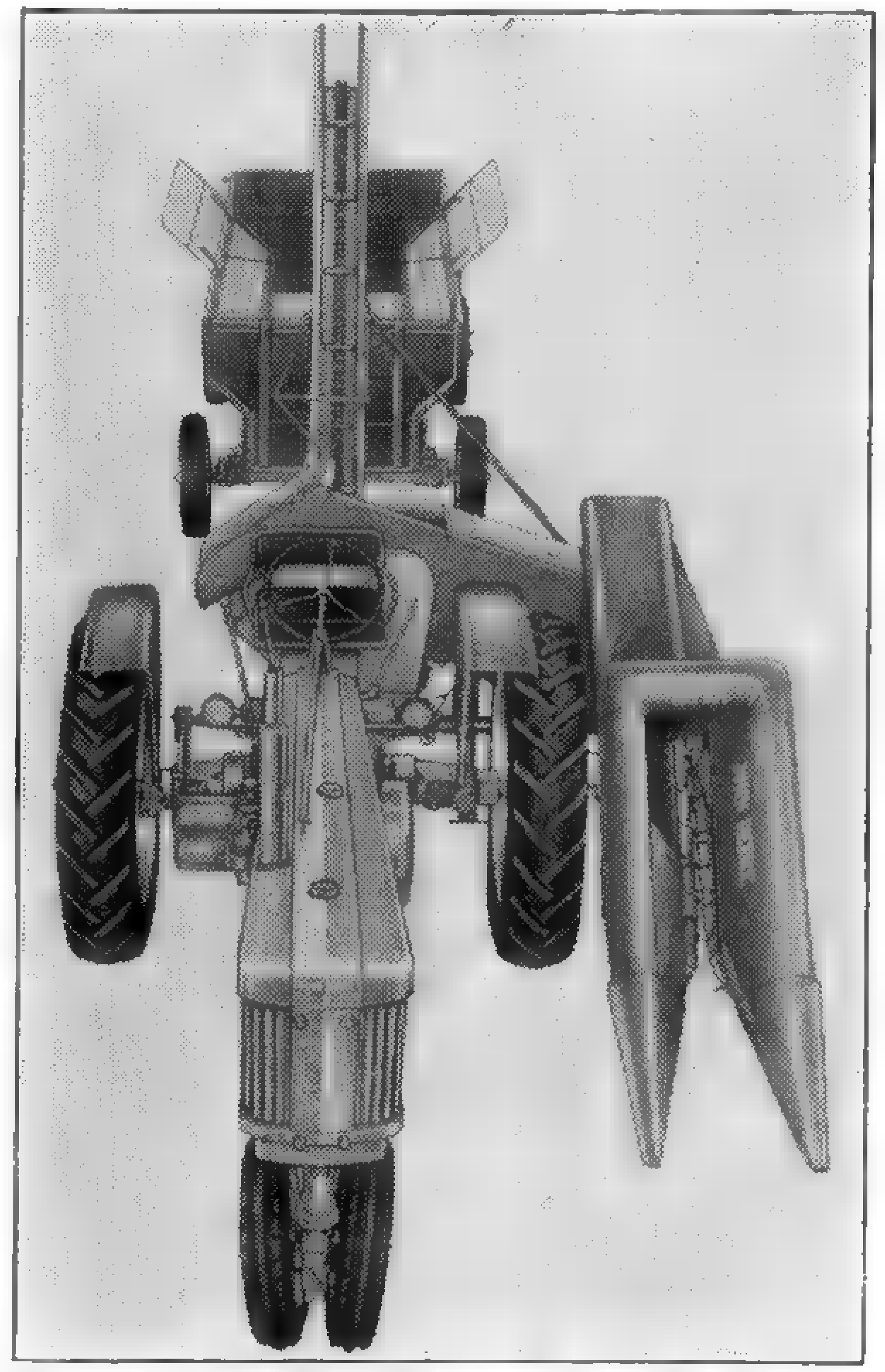


Figure 199—Front quarter view of wheel-and-drawbar-mounted one-row picker.

A tension spring at the upper end of the rolls permits obstructions to pass between the rolls without breakage of parts. It should be set with just enough tension to keep the gears well in mesh. Too much tension may cause breakage.

Husking Rolls. The husking rolls operate in pairs. They are held together under spring pressure at either end and are adjusted by tightening or loosening two nuts. There should be just enough tension on the rolls to cause them to grasp the husks when the smooth surfaces come together. Too much tension will increase the draft unnecessarily.

Movement of the ears over the rolls, of the machines illustrated in this chapter, is controlled to assure clean husking.

Wagon Elevator. The elevating unit carries the husked ears from the elevator hopper into the wagon. The hopper,

Figure 200—Overhead view of a two-row corn picker with tractor and wagon attached

into which the ears fall after the husking process is finished, is large enough to hold the surplus corn delivered to it when the elevator is stopped to change wagons and when turning.

The elevator drive is provided with a safety clutch (Fig. 202) which prevents breakage of chains and other

parts if the elevator becomes clogged. The same type of clutch is also provided on the gatherers, first elevator, husking rolls, and husk conveyor for the same purpose. The springs controlling these clutches should have just enough tension to hold the clutch in contact when the parts are working under normal load. If clogging occurs, and the added load throws the clutch out, the operator should stop immediately, locate and correct the trouble.

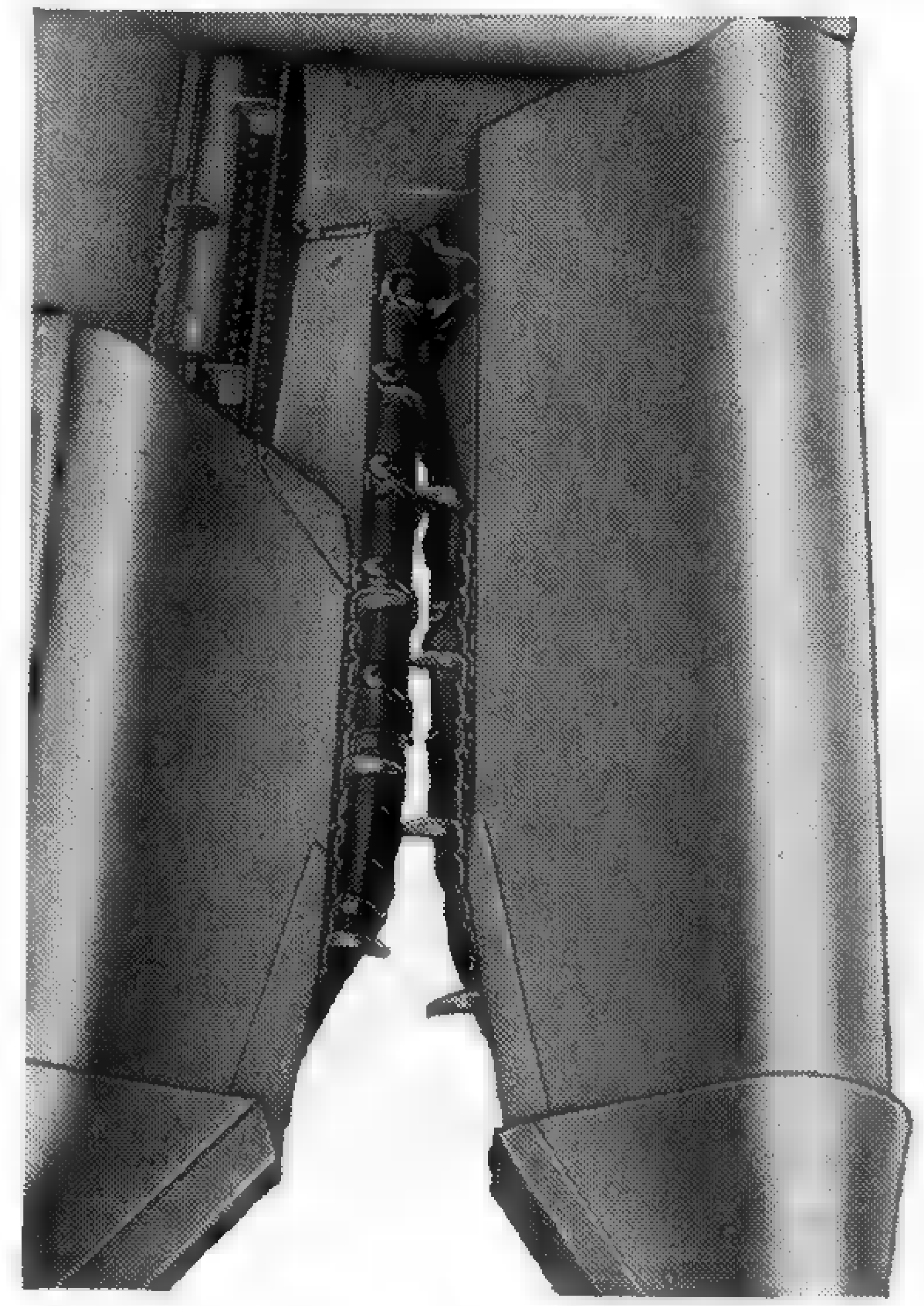


Figure 201—Above is shown a detailed drawing of the snapping unit and first elevator of a one-row picker. The top has been removed from the gatherer to show the working parts.

Oiling Important. The corn pickers shown are provided with roller and ball bearings at the important wearing points, all of which are supplied with facilities that make oiling easy.

All chains should be brushed with a light oil occasionally and should be run just tight enough to prevent jumping.

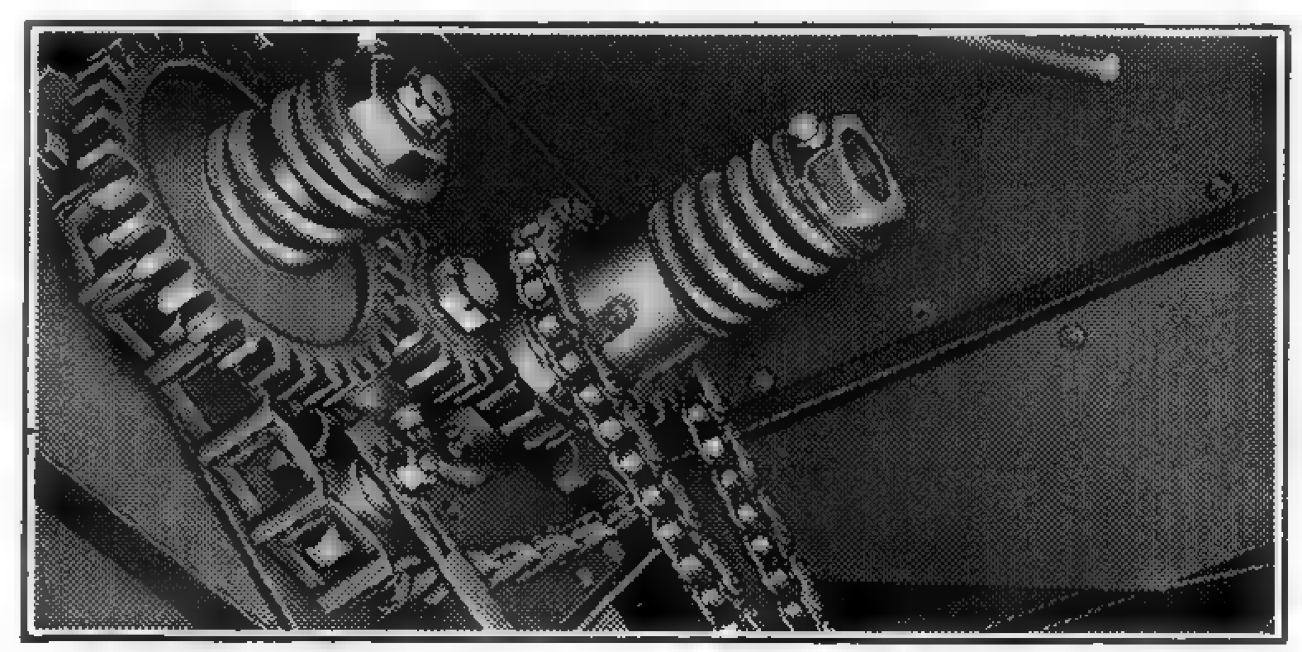


Figure 202—Slip clutches protect the main working parts of the corn picker against breakage should congestion occur.

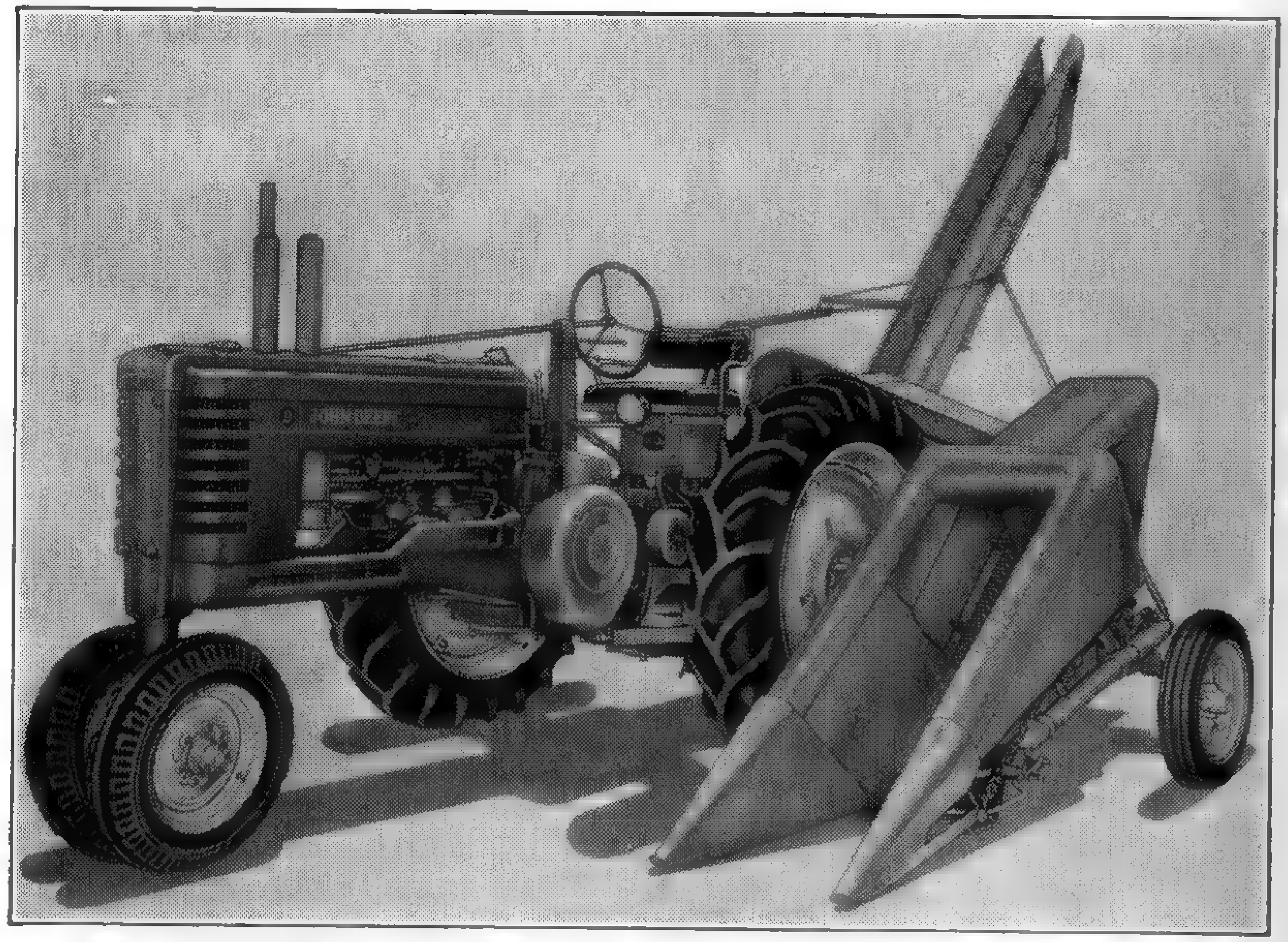


Figure 203—The one-row corn snapper is a wheel-and-drawbar-mounted snapper that's ideal for handling heavy crops.

Questions

1. *Describe three types of corn pickers and outline their differences.*
2. *Name the advantages of a corn picker over the hand-picking method.*
3. *Describe the operation of a corn picker.*
4. *What are the three main units of a picker, and what is their purpose?*
5. *Why are safety clutches used and how do they operate?*
6. *Tell the important points in caring for a corn picker.*

Chapter XVII.

POTATO DIGGERS

Modern potato diggers have taken much of the drudgery out of the potato harvest. They have reduced the waste common to the use of ordinary plows or hand-digging methods. A digger is practically a necessity to the economical production of potatoes for the market.

There are two styles of diggers in common use, angle bed and level bed as shown in Fig. 204. A further variation of the level bed digger is the double level bed digger especially adapted for light soil and extremely trashy conditions. On this digger, a single shovel spans two rows, to pass surface trash, soil, and potatoes onto the double elevators. Since the level bed digger is growing in popularity due to its gentler handling of the crop, a digger of this style is being used for illustration here. These types are furnished with various equipment units which adapt them to practically all harvesting conditions.

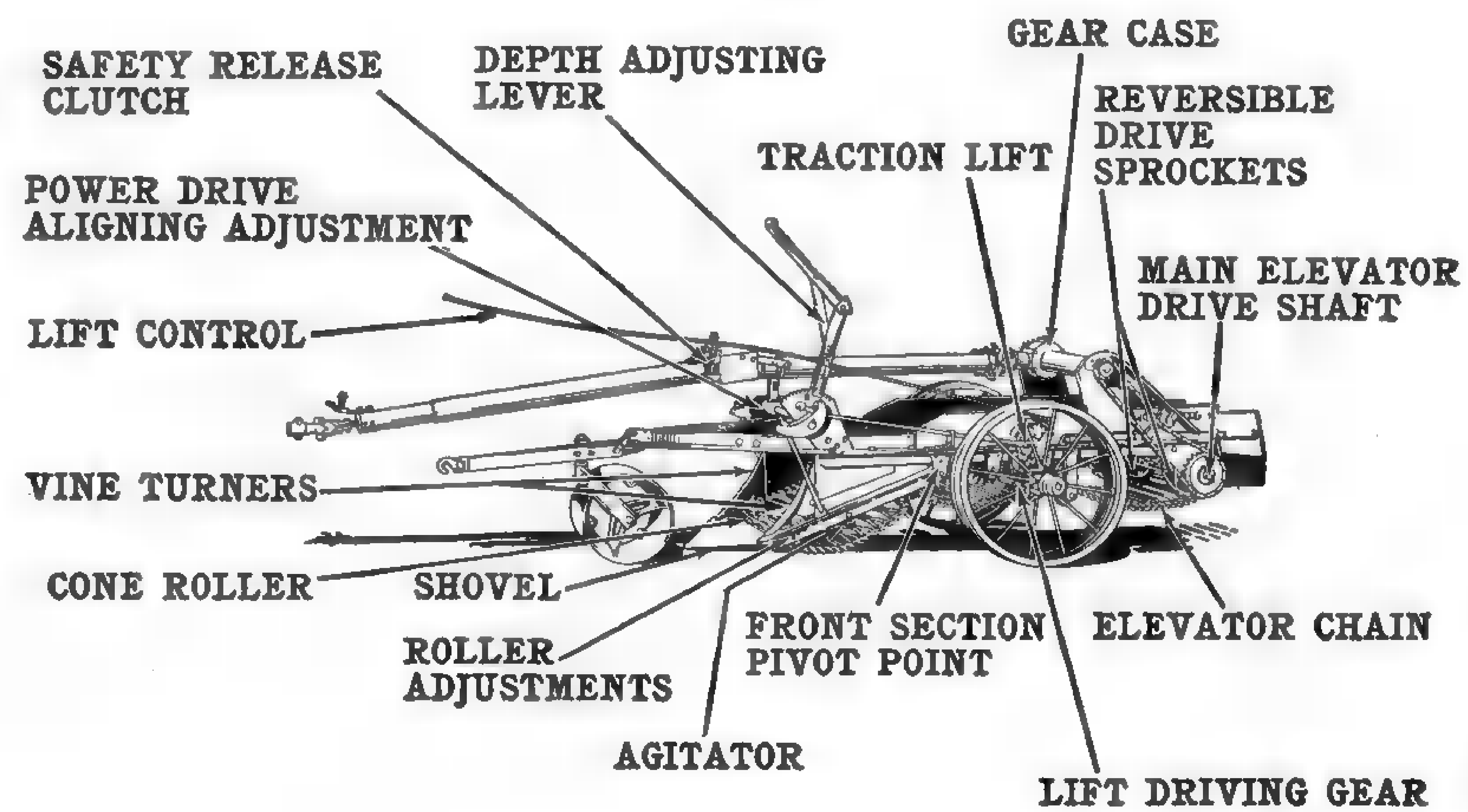


Figure 204—Level bed potato digger with important parts named.

Principle of Operation. The wide steel shovel, set to run at a safe depth below the potatoes, raises the potatoes, dirt, vines and all, onto the elevator. Depth is regulated by adjusting the lifting lever and beams.

The main object of the potato digger is to deliver clean potatoes on top of the soil. As stated above, the shovel, digging under the potatoes, loosens the soil and by the forward motion of the digger, the soil, potatoes, and vines are carried onto the elevator. The elevator is a continuous chain moving toward the rear of the machine. The earth drops through the elevator, aided by the agitating or up-and-down movement of the elevator. This agitation can be increased or decreased according to soil conditions by interchanging the smooth rollers and oblong agitating sprockets provided.

A shielded drive shaft, protected by a slip clutch, is used to transmit power direct from the tractor engine to operate elevators and separating mechanism.

The tractor-driven digger is especially advantageous under difficult conditions, as the speed of its power-driven elevator

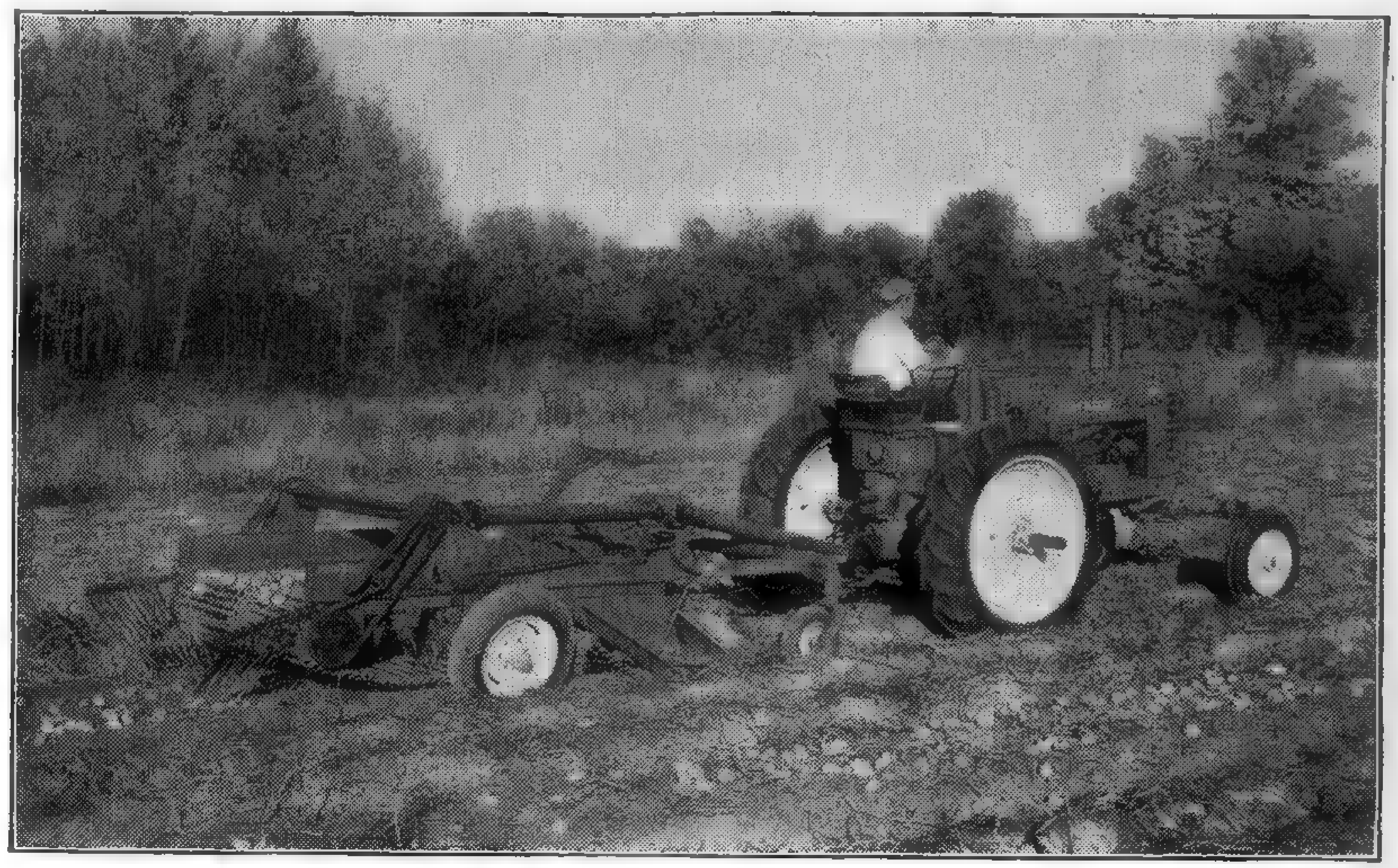


Figure 205—Two-row level bed digger at work.

is not affected by wheel slippage or by sudden slowing of forward travel.

The modern potato digger is provided with a wide variety of adjustments to meet practically all conditions encountered in the field. Special equipment units are available for many diggers to adapt them to unusual harvesting requirements. For these reasons, it is well for the operator to make a careful study of the manufacturer's instruction booklet to familiarize himself with his machine and thereby be prepared to take full advantage of its capabilities.

Since the potato digger must work effectively in dusty and gritty conditions, lifting tons of earth, trash, and potatoes, special attention should be given to thorough lubrication. Periodic check for badly worn or broken parts and replacement where necessary, will repay the operator in better service in the field.

Questions

1. *Name two types of potato diggers and tell the advantages of each.*
2. *Which type is most popular in your community?*
3. *Describe the action of an elevator digger.*

Chapter XVIII.

BEET HARVESTERS

In recent years beet growers have had a great need for a mechanical means of harvesting their crop. Many types of harvesters have been put on the market; few have proved satisfactory.

The harvester shown below, is one of the types that have proved successful in shortening the harvest job, eliminating the labor requirements which have become more and more a problem for beet growers, and doing a most satisfactory job of getting beets out of the field and to the beet dumps.

This beet harvester is made up in two units. The first unit is integral with the tractor. It cuts the tops off the beets, taking off all the leaves and a minimum of the crown. This unit windrows the beet tops for convenient picking if they are to be used for silage. The second unit is a drawn unit which digs the beets, separates them from the clods and clinging dirt, and loads them onto the trucks driven alongside. The beets are, in effect, squeezed out of the ground by fingers which exert pressure from the back and bottom. Less damage occurs than if beets are plowed or lifted.

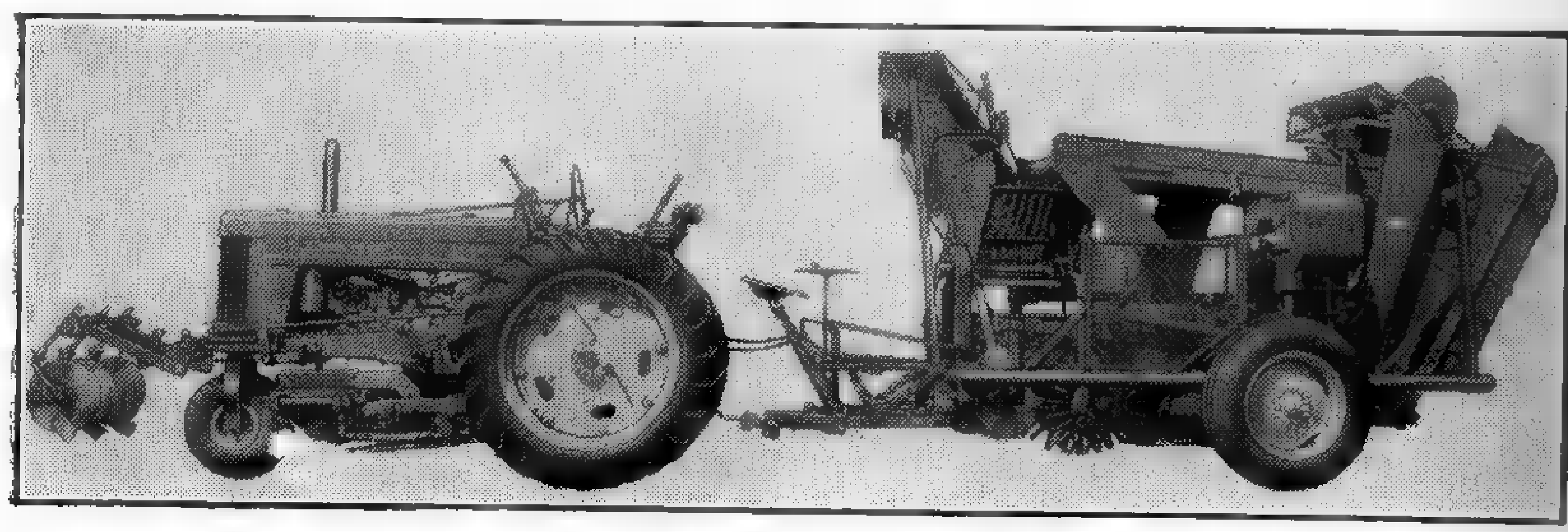


Figure 206—The 2-unit beet harvester.

Obviously an implement of this type demands utmost care in operation and repair. Therefore, refer to the manufacturer's operator's manual for complete details.

Questions

1. *How many types of beet harvesters have you seen?*
2. *What are the particular problems which make beet harvesting a hard mechanical job?*
3. *How many units are there in the beet harvester described and what are their functions?*
4. *What factors would you consider before buying a beet harvester for your farm?*

Chapter XIX.

HAMMER MILLS

The hammer mill has solved the feed-grinding problem on many farms, enabling the individual farmer to grind feed as the need arises and convenience permits, rather than to depend upon the custom grinder for this important work.

The modern hammer mill is designed to grind practically every type of feed, including small grain, shelled or ear corn, fodder, and hay, to the size best adapted to the feeding purpose for which it is intended. With the wide variety of screens available for present-day mills, feeds may be ground to any practical degree of fineness ranging from extremely fine meal or flour to coarse roughage.

Many of the present mills may be operated successfully by electric motors of 3 to 10 h.p. using the motor mounting attachment supplied by the manufacturer. Where electric power is available, the electric motor drive is used to power the mill while the farm tractor is free for other jobs.

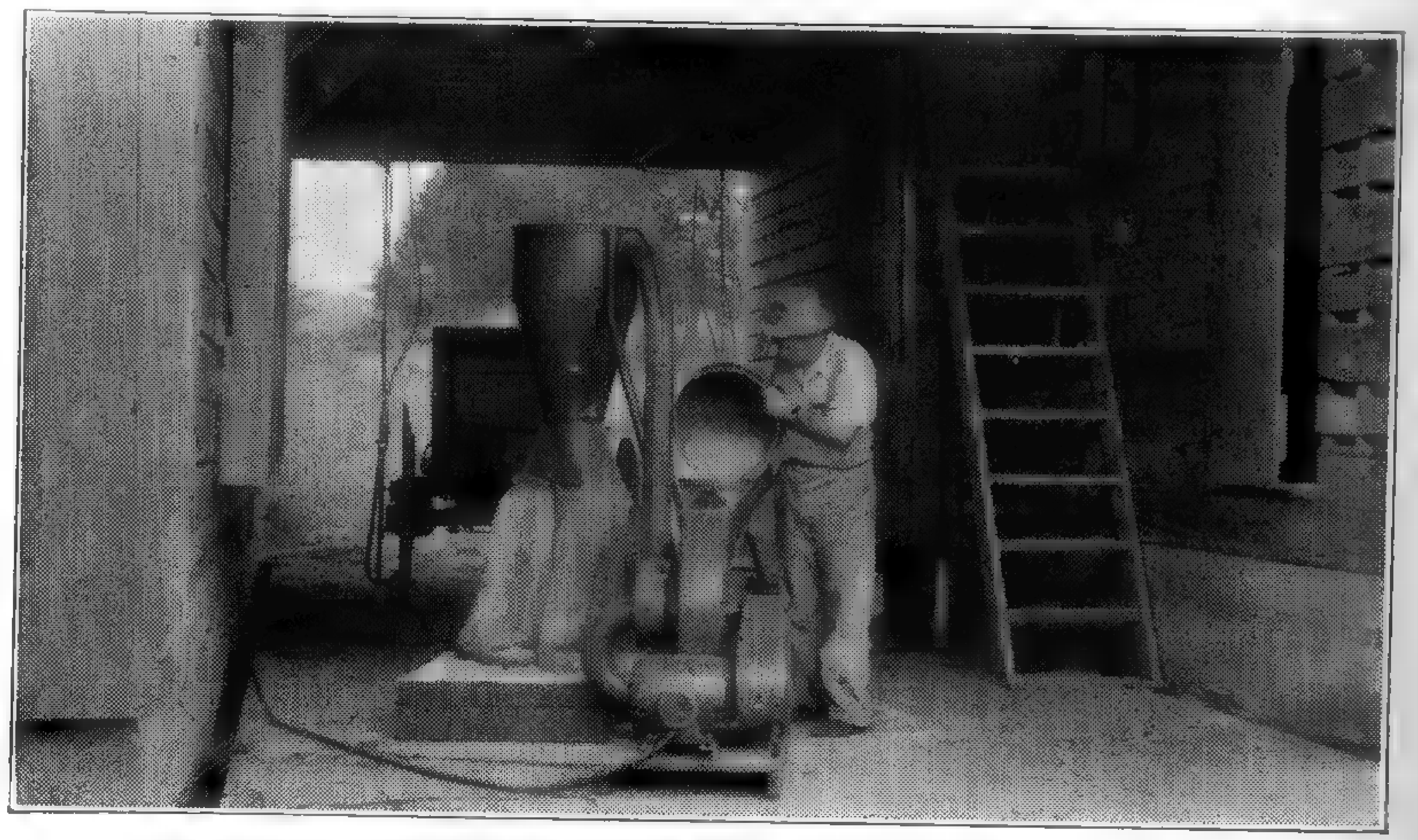


Figure 207—The small hammer mill is shown here powered by an electric motor.

Two units make up the hammer mill, as shown in Fig. 208. The material to be ground is fed into the chamber of the mill where the hammers, revolving at high speed, cut it in mid-air, throw it against the breaker bars to be picked up and recut until it is reduced to particles small enough to pass through the screen which determines the fineness of the grinding. As the ground material passes through the screen, a suction fan draws it from the mill and forces it through the blowpipe into the feed collector for final delivery to sacks, bins, or wagons.

The first step in preparing the hammer mill for operation is to select the proper screen, place it in the screen groove, and lock it in position, making certain that the screen and screen lock are seated properly. The air suction control should be set so that the proper amount of air is drawn through the screen for efficient grinding. When grinding on an extremely fine screen, more air should be drawn through the

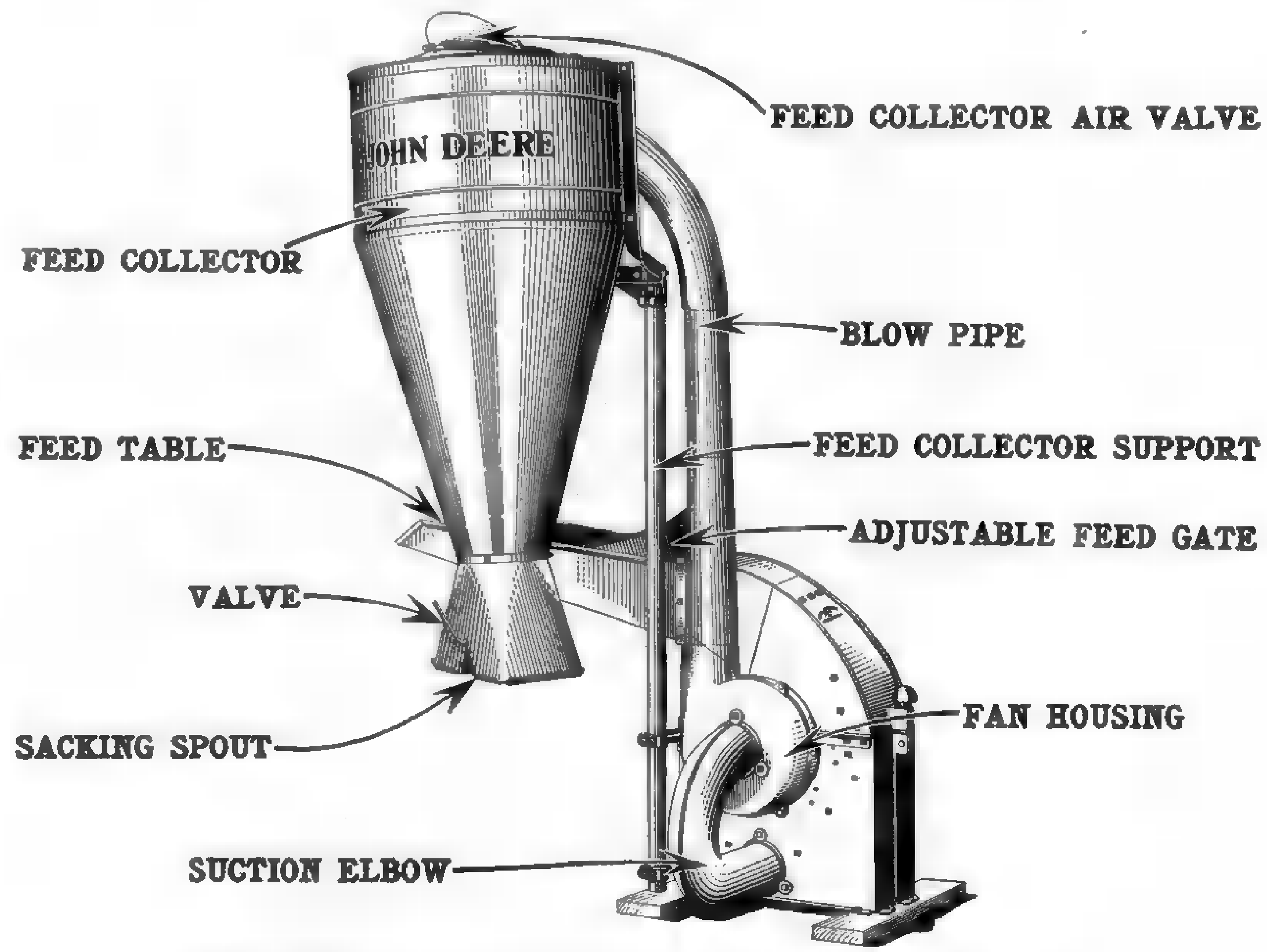


Figure 208—The hammer mill complete with feed collector.

screen so that light hulls, which, with a lighter suction, would rotate with the rotor, will be reduced quickly and drawn through the screen. When extremely coarse screens are used, the suction slide may be closed entirely. A two-piece feed control on the feed table governs the flow of material from the feed table to the mill: the smaller gate is used when feeding small grains (including shelled corn) while, for ear corn, both gates are raised just high enough to permit the ears to pass. Except when grinding hay or fodder, feed control should always be in place to regulate the air intake at the feed opening.

In adjustment, the hammer mill is free of complicated problems. There are, however, several basic facts which the

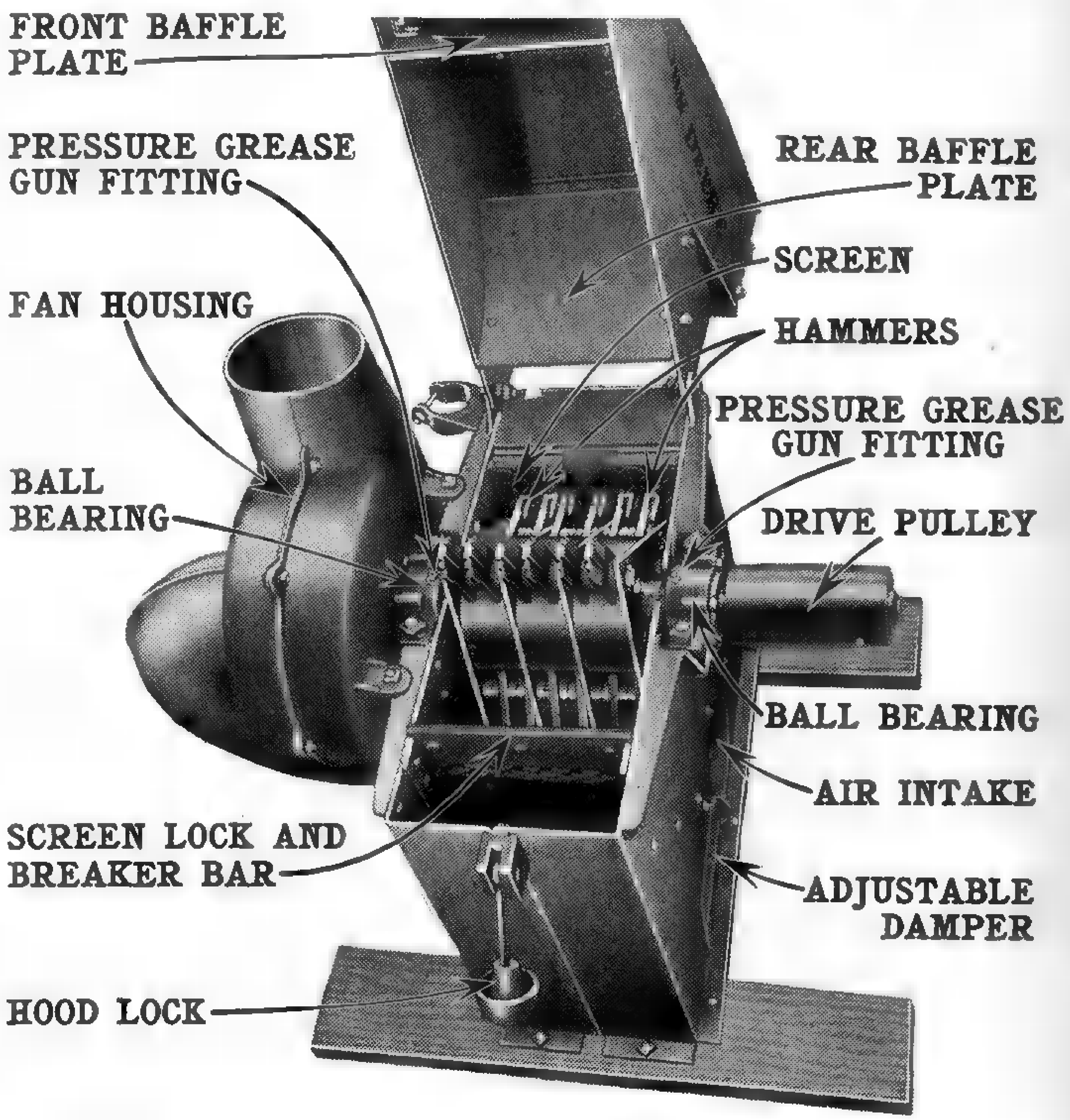


Figure 209—Detailed inside view of hammer mill showing rotor with hammers.

operator must keep in mind constantly. In the first place, the rotor shaft of the hammer mill turns at high speeds; therefore, special attention should be given to proper greasing and proper adjustment of all bearings. The rotor shaft, with the hammer mounting plates, hammers, and spacing collars, must be kept in proper balance to insure freedom from vibration which would damage the bearings and shorten the life of the entire mill. To preserve this balance, all hammers must be sharpened, reversed, or replaced at the same time; in reassembling, particular care must be used to make certain that all cast-iron spacing collars are replaced in their original order. If vibration appears, the mill should be stopped immediately and checked carefully for broken hammers. When replacing a broken hammer, it is well to replace the corresponding hammers in the other banks to insure proper balance, as any small difference in weight will result in vibration.

When hammers are dulled from wear, they may be re-

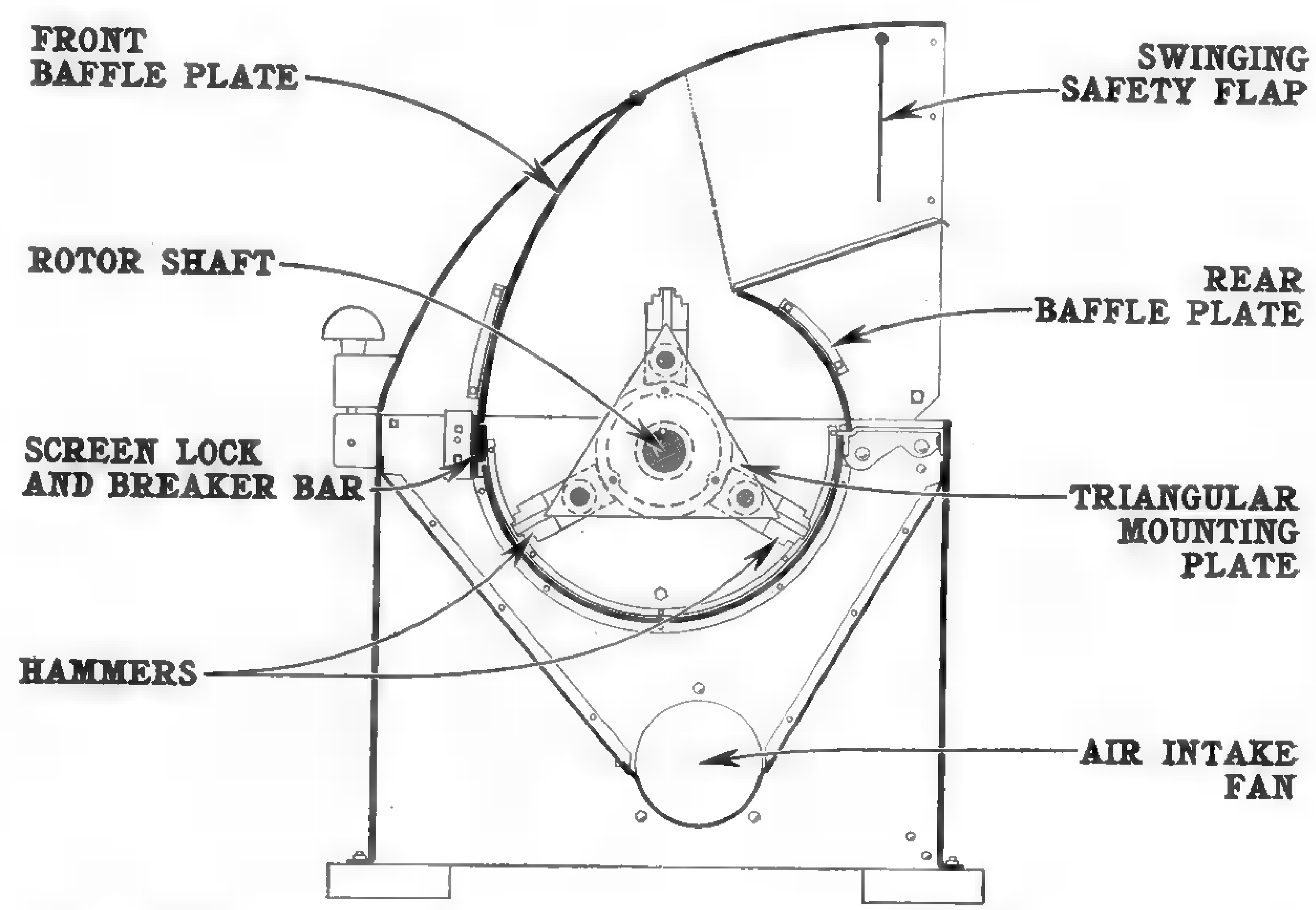


Figure 210—Cross-sectional view of mill showing relationship of operating parts.

versed to present new cutting steps. When both edges are dulled, hammers may be removed and sharpened on a good emery wheel. This is an important servicing operation, for the hammers must retain their original cutting steps for effective work. To insure best service from the hammer mill, hammers should be ground before they become too badly worn.

The blower and feed collector require but little attention other than an occasional inspection to be sure all joints are tight. An air control damper is provided so that the blast of air can be controlled to eliminate loss of light or exceptionally fine material. Thus, the operator may adjust the air pressure to insure proper movement of the ground material without forcing finely-ground meal through the sack.

Highly important in the successful operation of any hammer mill is the maintenance of rated speed as specified by the manufacturer of the mill.

Careful attention to lubrication and to proper adjustment of all moving parts will result in efficient operation and long life of the mill. Where the mill is used in the open, it should be covered when not in use to prevent damage by exposure to rain and snow. A periodic cleaning and inspection will repay the operator in smoother, more efficient operation.

Questions

1. *What is the most important point in the efficient operation of the hammer mill?*
2. *If your hammer mill developed excessive vibration, where would you look for trouble? How would you correct it?*
3. *How would you replace a complete set of hammers? A broken hammer? How would you sharpen the hammers?*
4. *What is the double purpose of the fan?*
5. *What is the purpose of the feed control?*
6. *What causes finely-ground feed to sift through the sack? How would you remedy this condition?*
7. *How would you regulate the air control for extremely coarse grinding? Extremely fine?*

PART SIX

SOIL FERTILITY

Soil is the source of food that sustains mankind. It is productive so long as it contains sufficient quantities of all the essential plant-food elements, and so long as the right methods are observed by the farmer in working his land.

The supply of plant-food elements in the soil is not inexhaustible. Like a bank account, it becomes depleted if the amount withdrawn is greater than the amount deposited.

With the removal of each crop, the soil surrenders some of its fertility. If an equal amount of fertility is returned by man, productiveness is maintained.

Chapter XX.

MANURE SPREADERS AND LOADERS

Experience has proved to farmers, in every section of the country, that barnyard manure is of great value as a soil fertilizer and a factor in permanent agriculture. The insistent

Figure 211—The modern [redacted] spreader is a valuable soil-builder.

urgings of scientists and farm experts have moved farmers to try a regular plan of covering their fields with the manure and waste vegetable matter from their barns and feed yards. The results have proved gratifying and, as a general rule, farmers value highly the manure that was once considered a useless by-product of farming that was to be disposed of in the easiest possible manner or permitted to rot and waste away in piles about the barnyard.

One of the major reasons for the wastage of manure in the early days of agricultural expansion was the great amount of hand labor required to get it distributed evenly over the fields. The hard work of pitching into high wagon boxes, unloading into piles, and spreading by hand or spreading direct from the load was distasteful even to the farmer who was most conscientious about maintaining the fertility of his fields. The result was a more or less general laxity in conserving the manure that is now valued so highly.

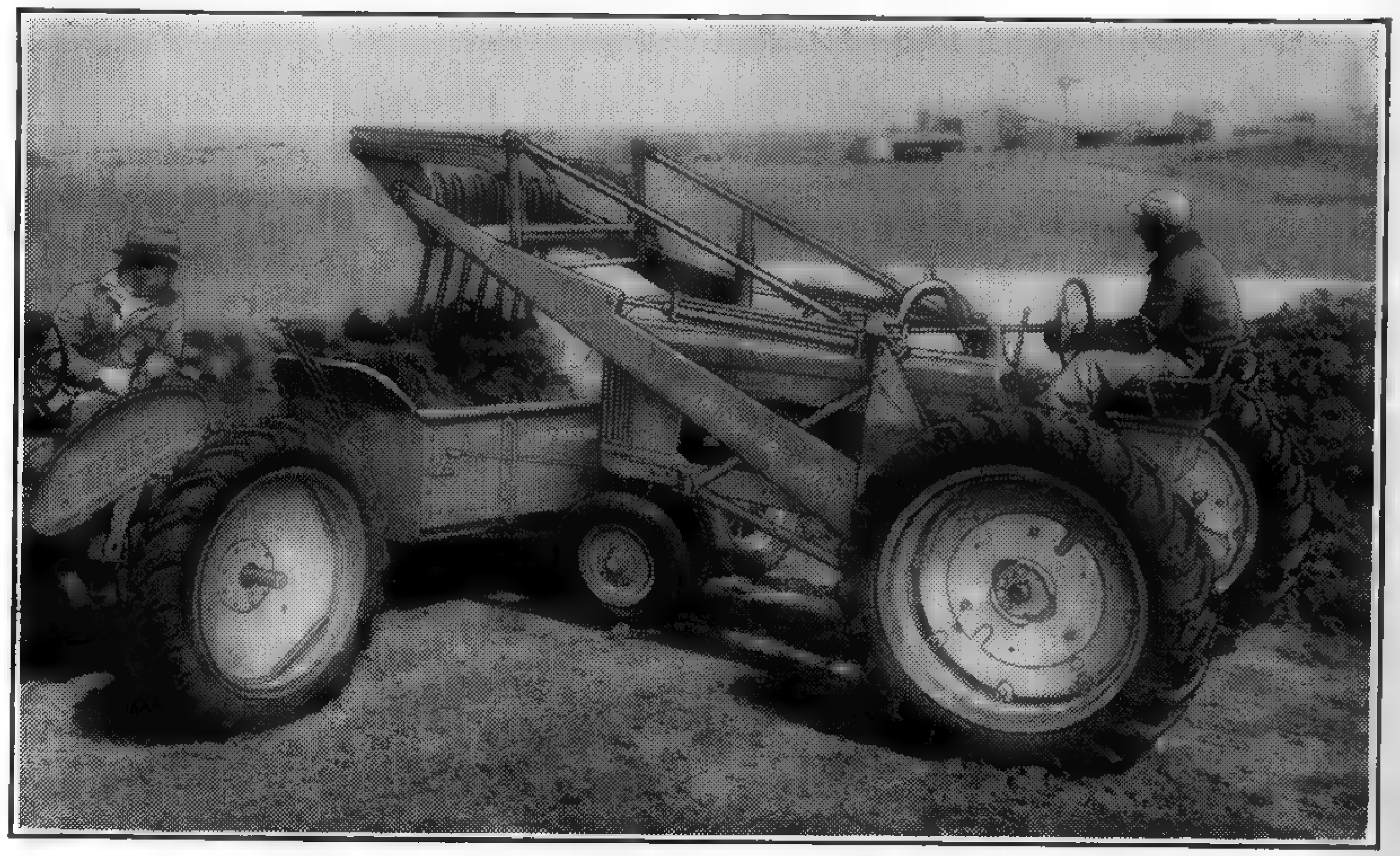
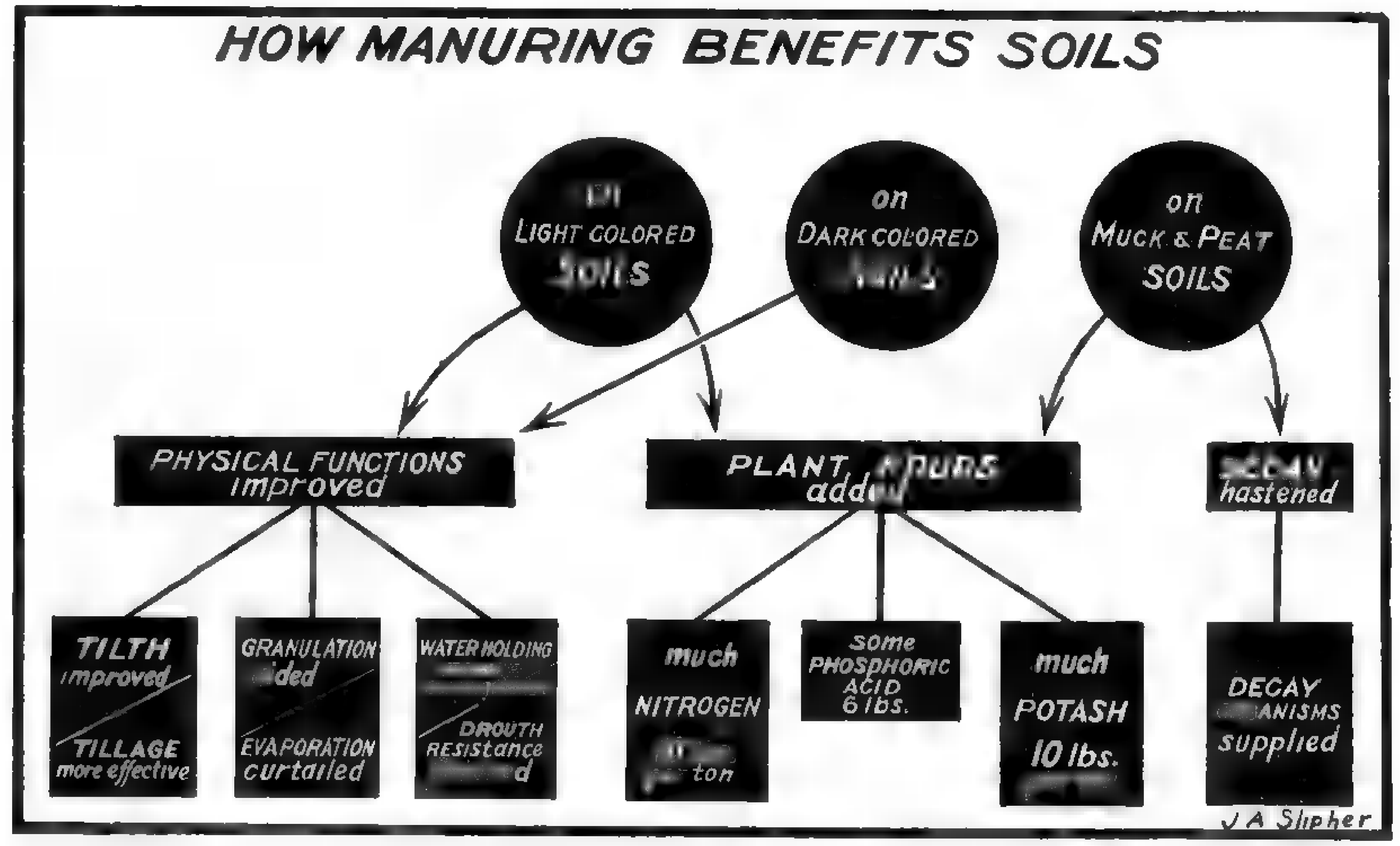
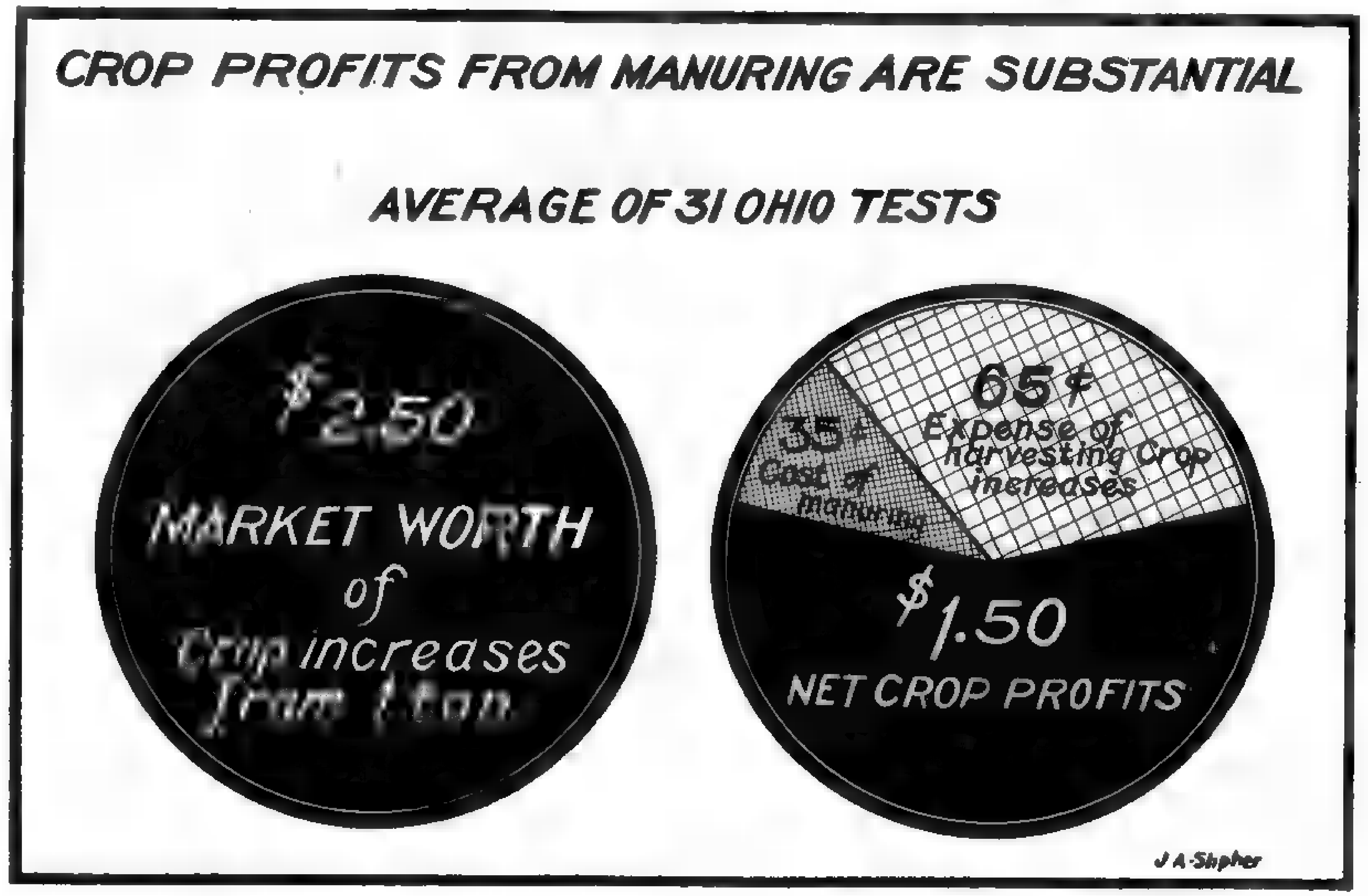
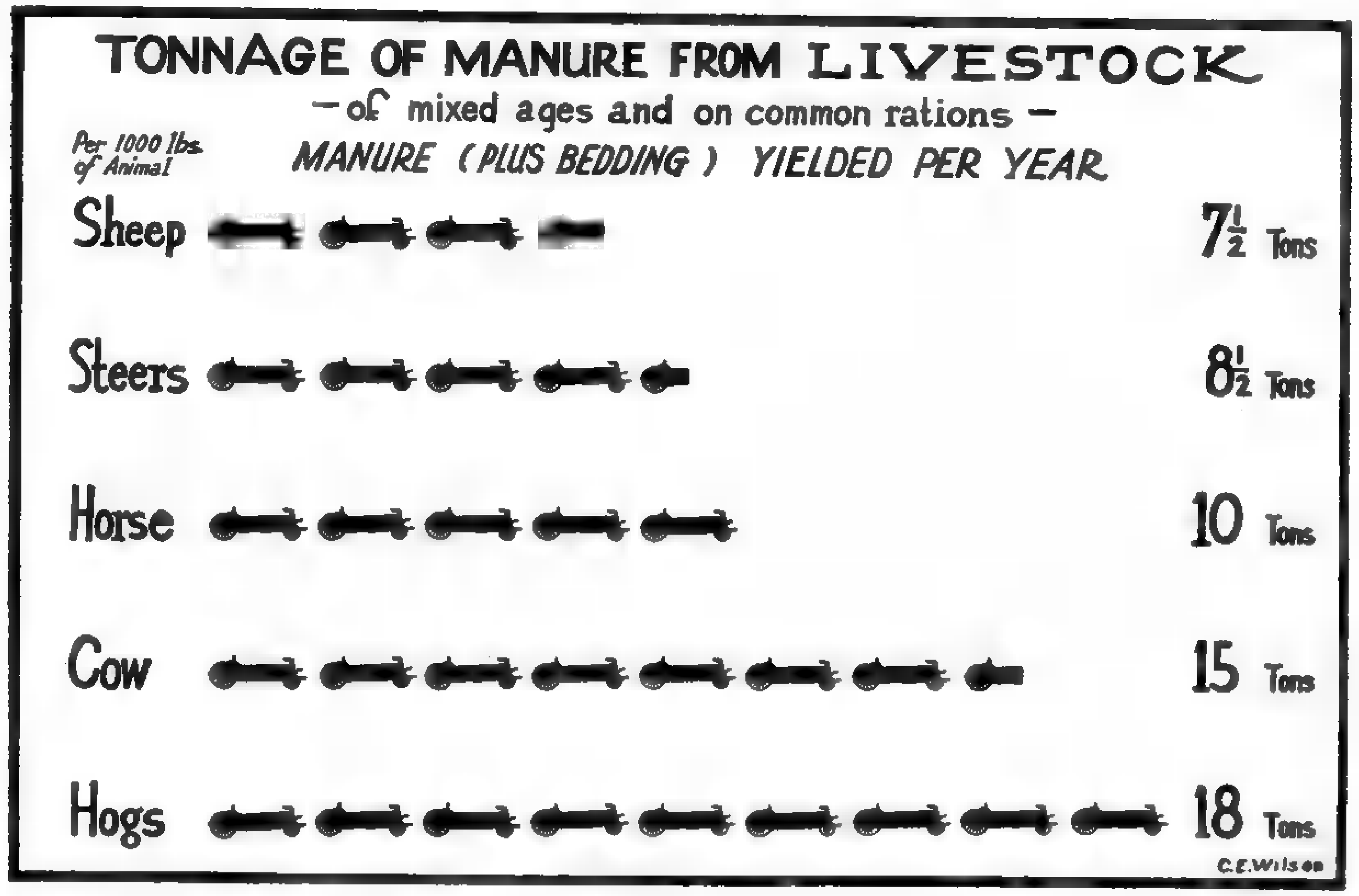


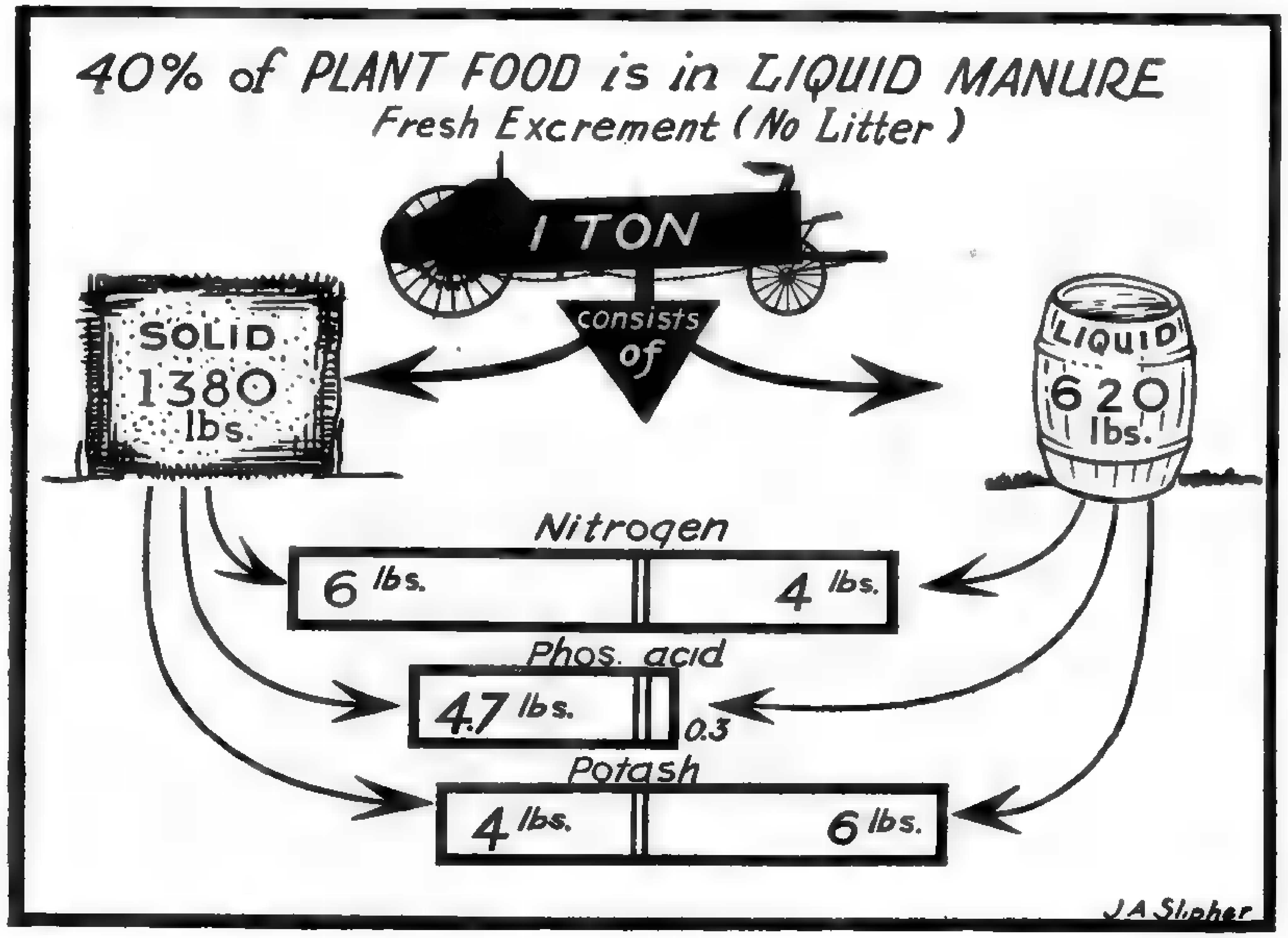
Figure 212—The push-type loader does a fine job of cleaning up [illegible] in barns and feed lots.

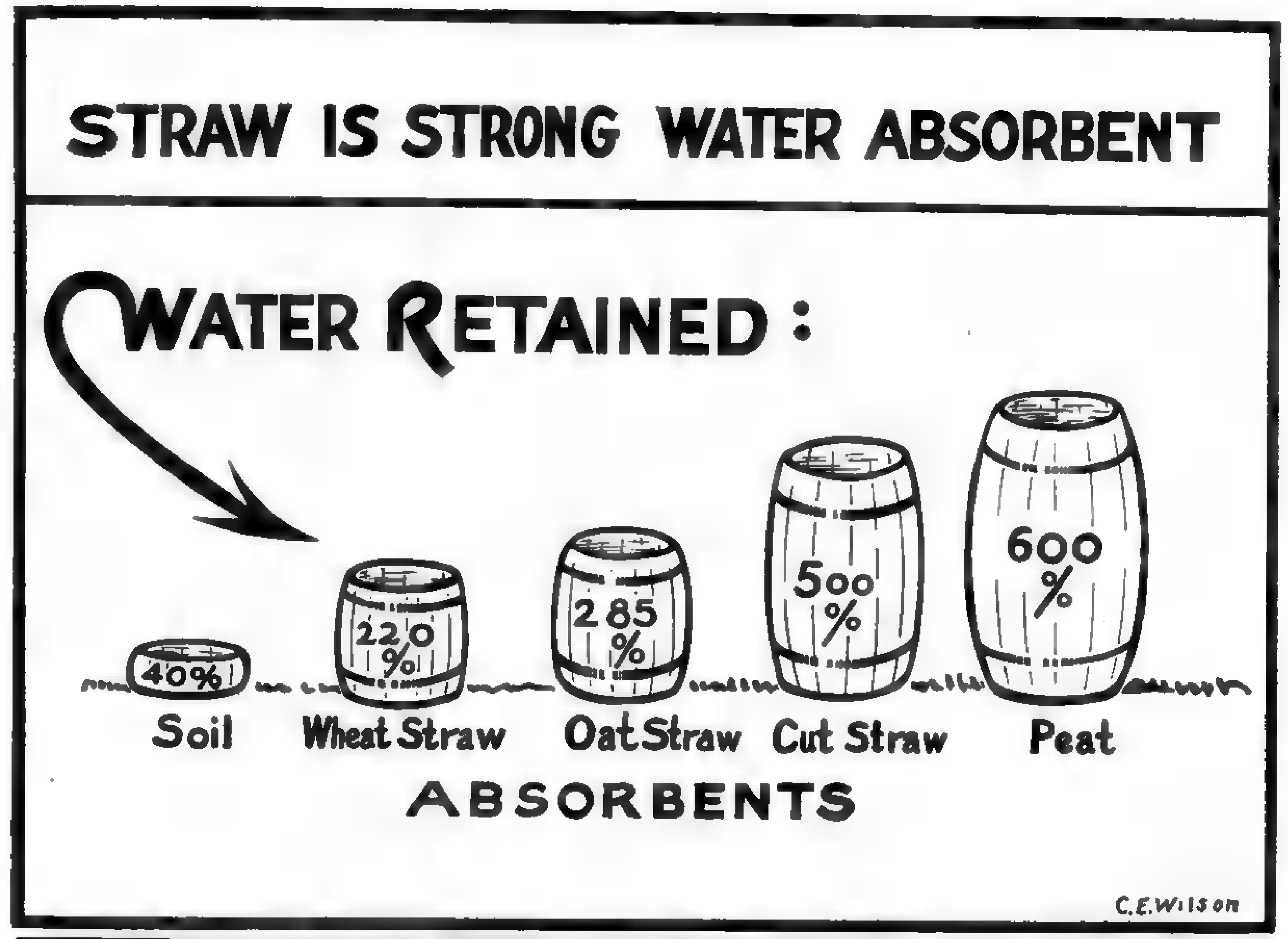
The following graphs, furnished through courtesy of the Ohio State University, supply interesting facts about the value of manure in maintaining soil fertility and, in addition, show results obtained from various methods of handling manure.

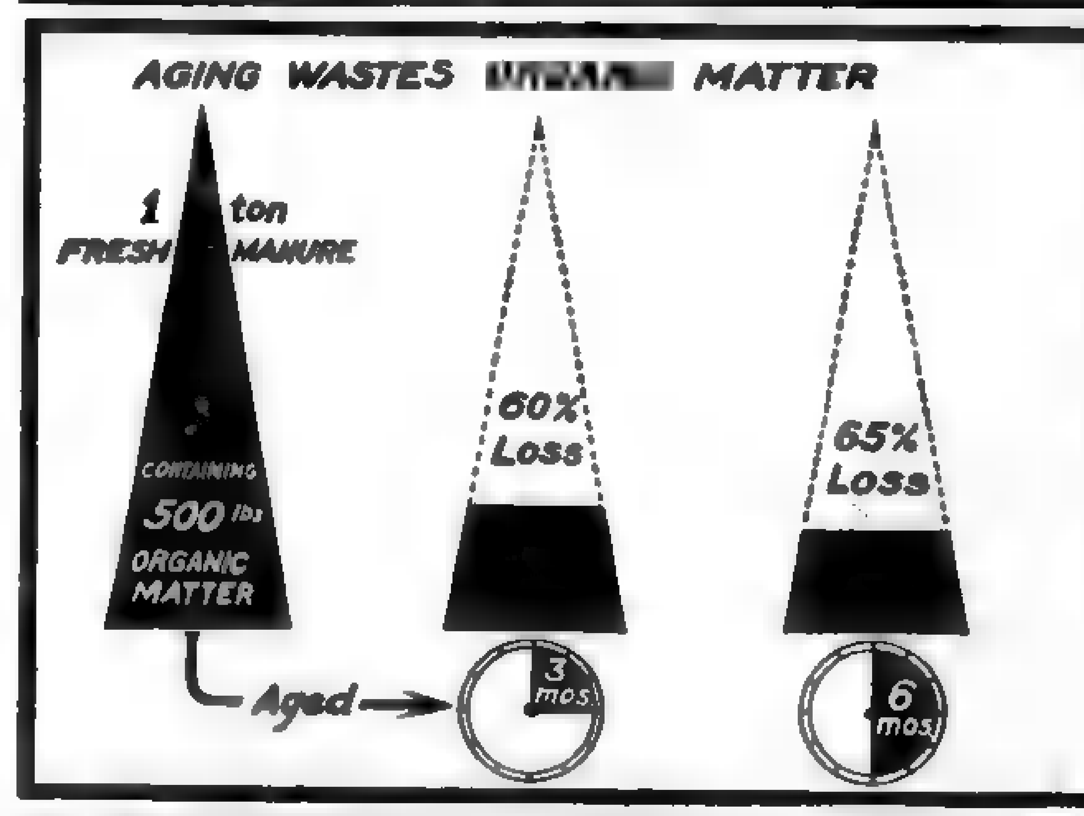


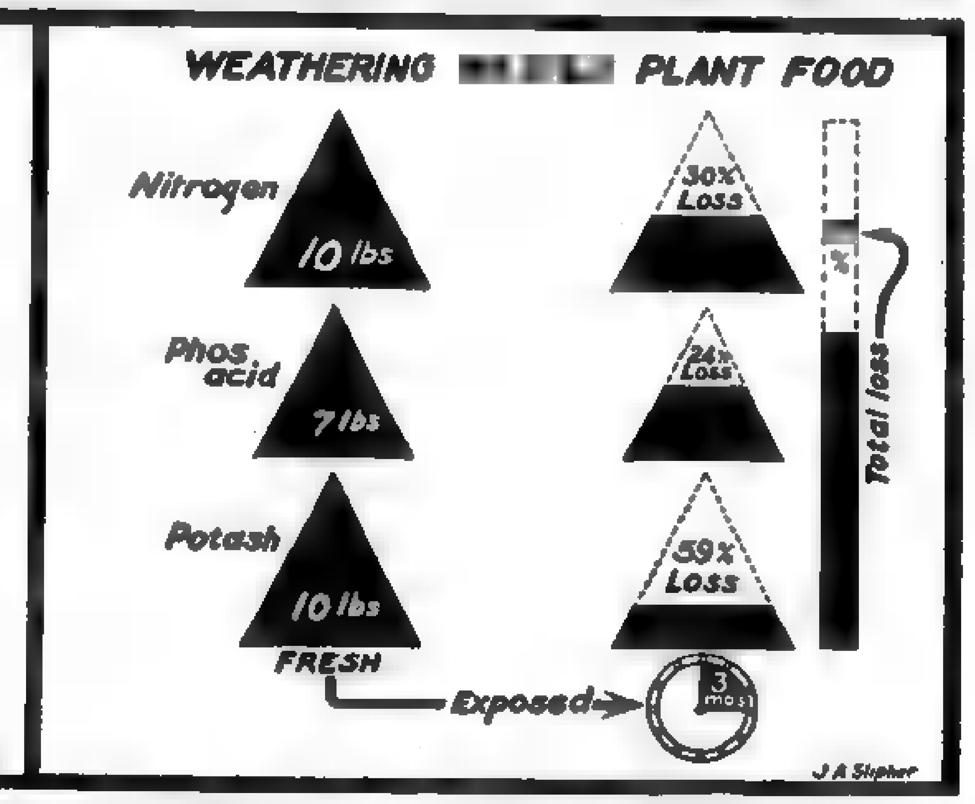


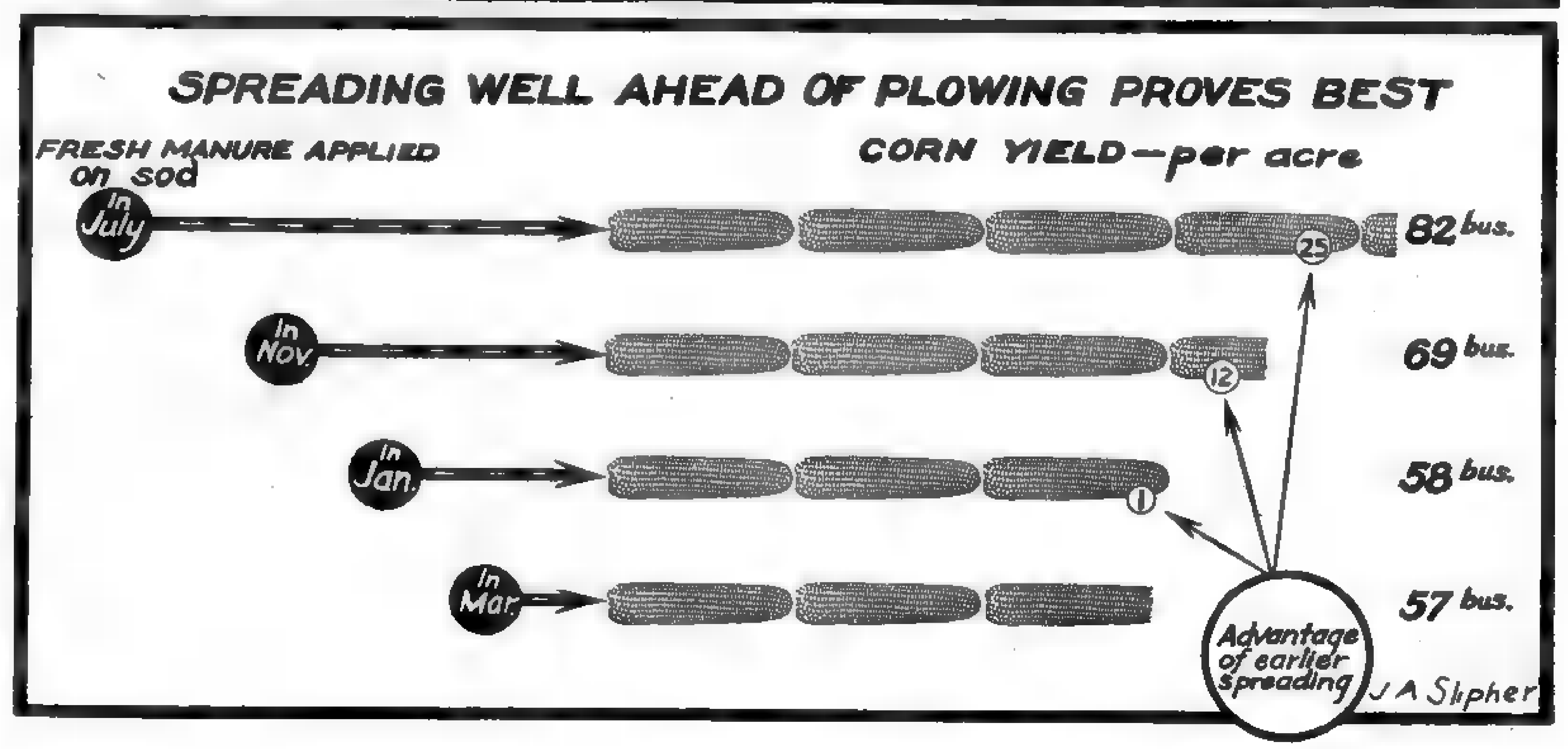

TONNAGE OF MANURE FROM LIVESTOCK
– of mixed ages and on common rations –
Per 1000 lbs. of Animal
MANURE (PLUS BEDDING) YIELDED PER YEAR
Sheep 7½ Tons
Steers 8½ Tons
Horse 10 Tons
Cow 15 Tons
Hogs 18 Tons
C.E.Wilson

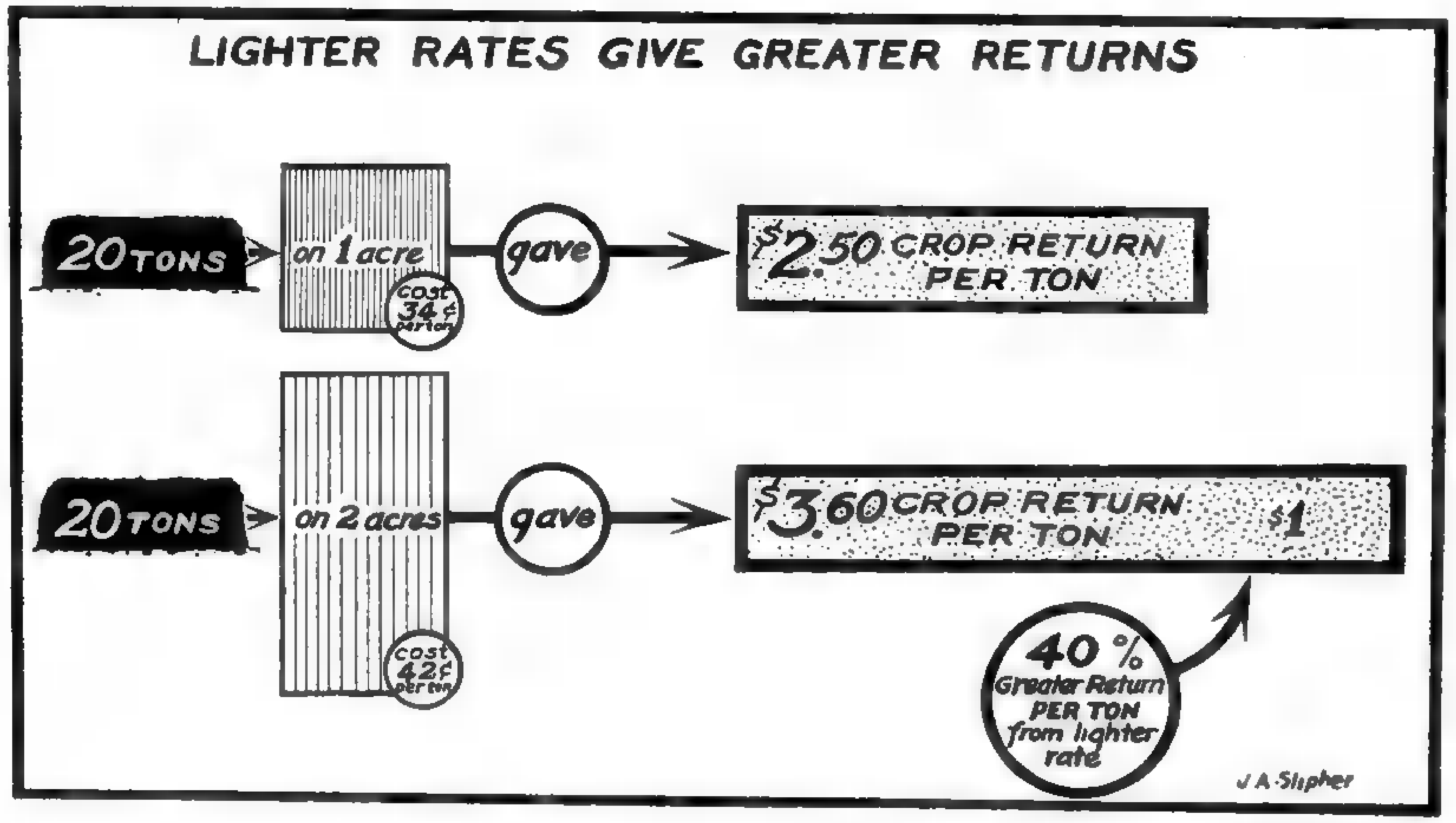

40% of PLANT FOOD is in LIQUID MANURE
Fresh Excrement (No Litter)
1 TON
consists of
SOLID 1380 lbs.
LIQUID 620 lbs.
Nitrogen
6 lbs.
4 lbs.
Phos. acid
4.7 lbs.
0.3
Potash
4 lbs.
6 lbs.
J.A.Slipher


STRAW IS STRONG WATER ABSORBENT
WATER RETAINED:
40%
220 %
285 %
500 %
600 %
Soil
Wheat Straw
Oat Straw
Cut Straw
Peat
ABSORBENTS
C.E.Wilson


AGING WASTES [redacted] MATTER
1 ton FRESH MANURE
CONTAINING 500 lbs ORGANIC MATTER
60% Loss
65% Loss
Aged
3 mos
6 mos


WEATHERING [redacted] PLANT FOOD
Nitrogen
10 lbs
50% Loss
Phos. acid
7 lbs
24% Loss
Potash
10 lbs
59% Loss
FRESH
Exposed
3 mos
Total loss
J.A.Slipher


SPREADING WELL AHEAD OF PLOWING PROVES BEST
FRESH MANURE APPLIED on sod
CORN YIELD—per acre
In July
82 bus.
25
In Nov.
69 bus.
12
In Jan.
58 bus.
1
In Mar.
57 bus.
Advantage of earlier spreading
J.A.Slipher



Mechanical Spreaders. The introduction of the manure spreader not only gave the farmer an easier and quicker method of spreading his barnyard manure, but it also paved the way for a more concentrated effort on the part of agricul-

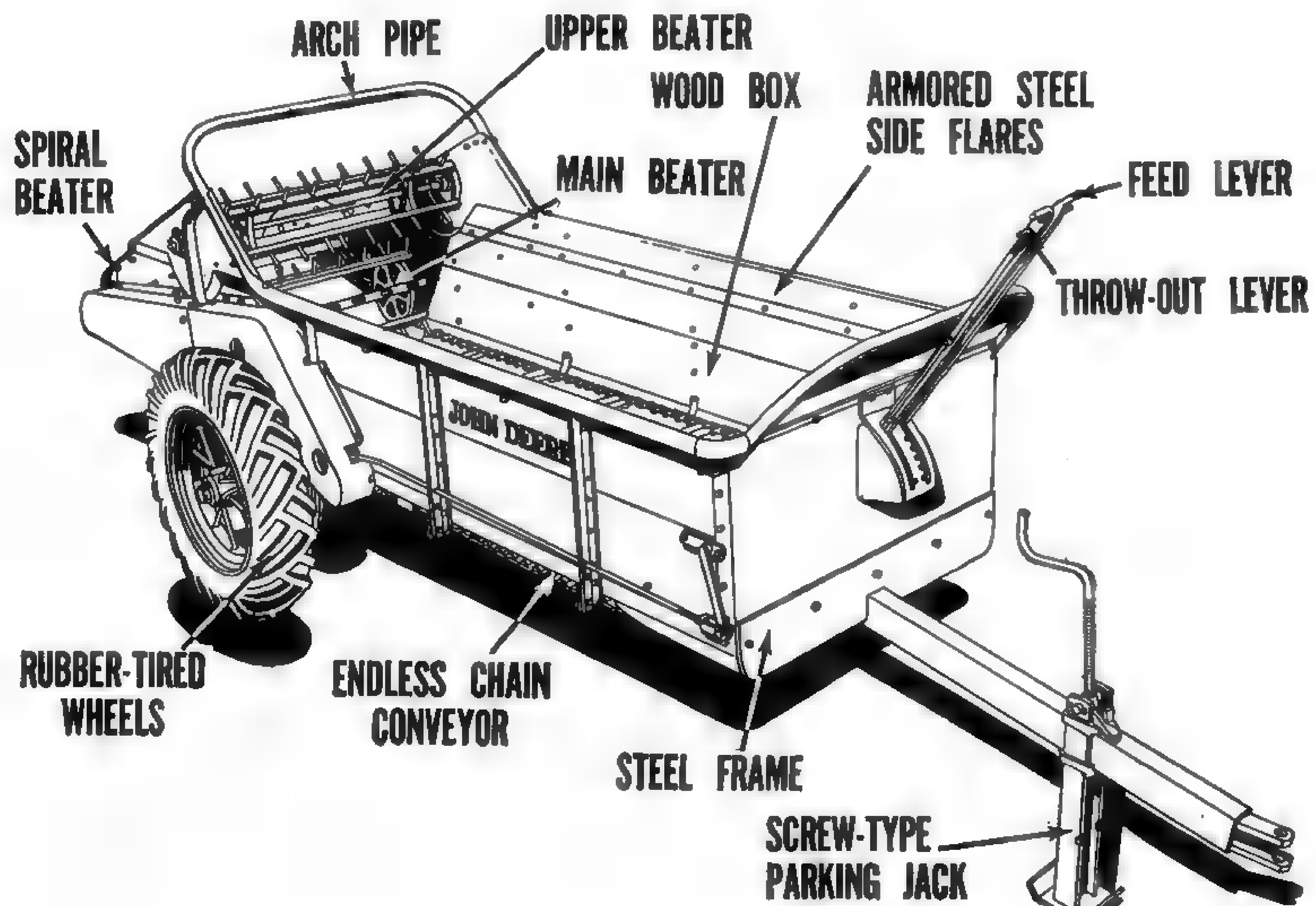


Figure 213—Tractor spreader of the two-wheel type.

tural leaders to impress upon him the value of its use in increasing crop production. Winning the farmer to the use of the spreader was comparatively easy when both the labor-saving and crop-producing features were pointed out to him.

Today, the great majority of farms are equipped with some type of manure spreader. Farmers are adding to their profits and building up their soils by utilizing the manure that was once wasted. The general practice is to spread the manure on the fields as it accumulates, thus getting the full benefit of all the plant-food elements.

To be most effective, manure must be spread evenly over the entire surface of the field. If it is deposited in bunches, part of the soil is without fertilizer and part is oversupplied. If the manure has a large amount of straw in it, difficulty is experienced in plowing and cultivating spots where it is bunched. The proper loading and operating of the manure spreader will overcome or lessen the possibilities of uneven spreading, provided the spreader is constructed properly.

Types of Spreaders. The tractor spreader, shown in Fig.

Figure 214—Returning fertility and humus to the soil with a horse-drawn spreader.

213, is of the two-wheel type, with front end supported by the tractor. The direct hitch serves two important purposes: it reduces the over-all length of the outfit, permitting the operator to work in close quarters, and it distributes the weight over spreader and tractor wheels for ample traction in wet or slippery fields and feed lots.

Operating levers are placed on the spreader for easy accessibility from the tractor seat. The stand or supporting foot which supports the spreader, when not in use, is raised or lowered from the tractor seat by means of the lever on the stub pole.

The three beaters serve to break up or shred the manure and distribute it in the quantity required. The upper and main beaters shred the manure; the spiral beater deposits it evenly over the entire width, making a well-defined line beyond the drive wheels.

The manure is carried back to the beaters by a steel slat conveyor, the speed of which is controlled by the feed lever placed well forward on the spreader. From five to twenty loads can be spread per acre, according to the setting of the feed lever.

The operator must be sure to keep the feed lever forward in neutral, whenever the machine is not in gear or whenever the beaters are not operating. If the feed lever is left in operating position when starting to the field with a load, the conveyor forces the load back against the beater, resulting in breakage in some part of the feed mechanism. The feed lever should be thrown into neutral, also, when turning sharply while spreading.

With the control lever, the operator shifts the main drive chain so that it is in contact with the large drive sprocket. The three beaters are driven by two chains, both of which are set into action by the drive sprocket. The beaters should not be put into gear in this manner while the machine is in motion. The control lever should be moved to the rear only when the spreader is standing still.

A four-wheel horse-drawn spreader, similar in construction to the tractor-drawn spreader, is shown at work in Fig. 214. Levers are placed for convenient operation from the driver's seat.

Building the Load. In building the load, it is best to start at the front of the spreader and finish at the beater end. The shredding process, which is the work of the beaters, imposes less strain on the spreader when the load is built in this manner, resulting in lighter draft and less wear on the machine.

Manure Loaders. Cleaning up manure in feed lots and around buildings has always been a problem for feeders and dairymen. Valuable as manure is, many farmers have been forced by pressure of other farm work to let it lie unspread, wasting its plant-food elements until time could be found to haul it to the field.

Modern manure loaders speed up the work of loading spreaders and relieve the operator of the hard, disagreeable job of pitching manure by hand.

The push-type loader, is a fast, easily operated loader, ideal for the "one tractor" farmer since the tractor equipped with this loader may be used for hauling the spreader as well as for loading. The push-type loader has a distinct advantage in working in close quarters in feed lots and sheds. Like all modern tractor-mounted equipment, the push-type loader is controlled from the tractor seat. Power for the loader, shown in Figure 212, is supplied direct by hydraulic power so that the loader may be operated whenever the tractor engine is running.

Highly important in the operation of the manure loader is proper lubrication of all parts. Time devoted to an occasional check-up to make certain that all parts are in alignment and all connections tight will repay the operator in fast, efficient work.

Questions

1. *What relation has soil fertility to the production of food?*
2. *Name the types of fertilizer used on farms in your community.*
3. *What are the advantages of using a manure spreader over hand-spreading methods?*
4. *How should manure be spread to be of most value?*
5. *How would you build a load of manure for best results?*
6. *How is the quantity to be spread per acre controlled?*
7. *Why is thorough oiling important?*
8. *What percent of farms in your neighborhood are equipped with manure spreaders?*
9. *What advantages does the modern manure loader offer to feeders and dairymen?*
10. *Describe the front-end manure loader and tell how it is operated.*
11. *What servicing operations are especially important?*

Chapter XXI.

LIME AND FERTILIZER SOWERS

In every section of the country, there are soils that would produce better crops with the application of lime, the proper commercial fertilizer, or a combination of both. Sour or acid soils that have been depleted of their lime by constant cropping or poor drainage can be rejuvenated and their productivity greatly increased by the application of lime. "Worn-out" soils can be brought back to a productive state with commercial fertilizers and lime applied in correct amounts. The lime sower affords the easiest and most economical method of distributing these materials

Lime and fertilizer distributors are made with two types of feeds—the star force-feeds that handle from 30 to 3,000 pounds per acre, and the rotary wing feeds that sow from 200 to 20,000 pounds per acre. This latter type, when equipped with pneumatic tires, is used for distributing calcium chloride, cinders, salt, and other materials on roads.

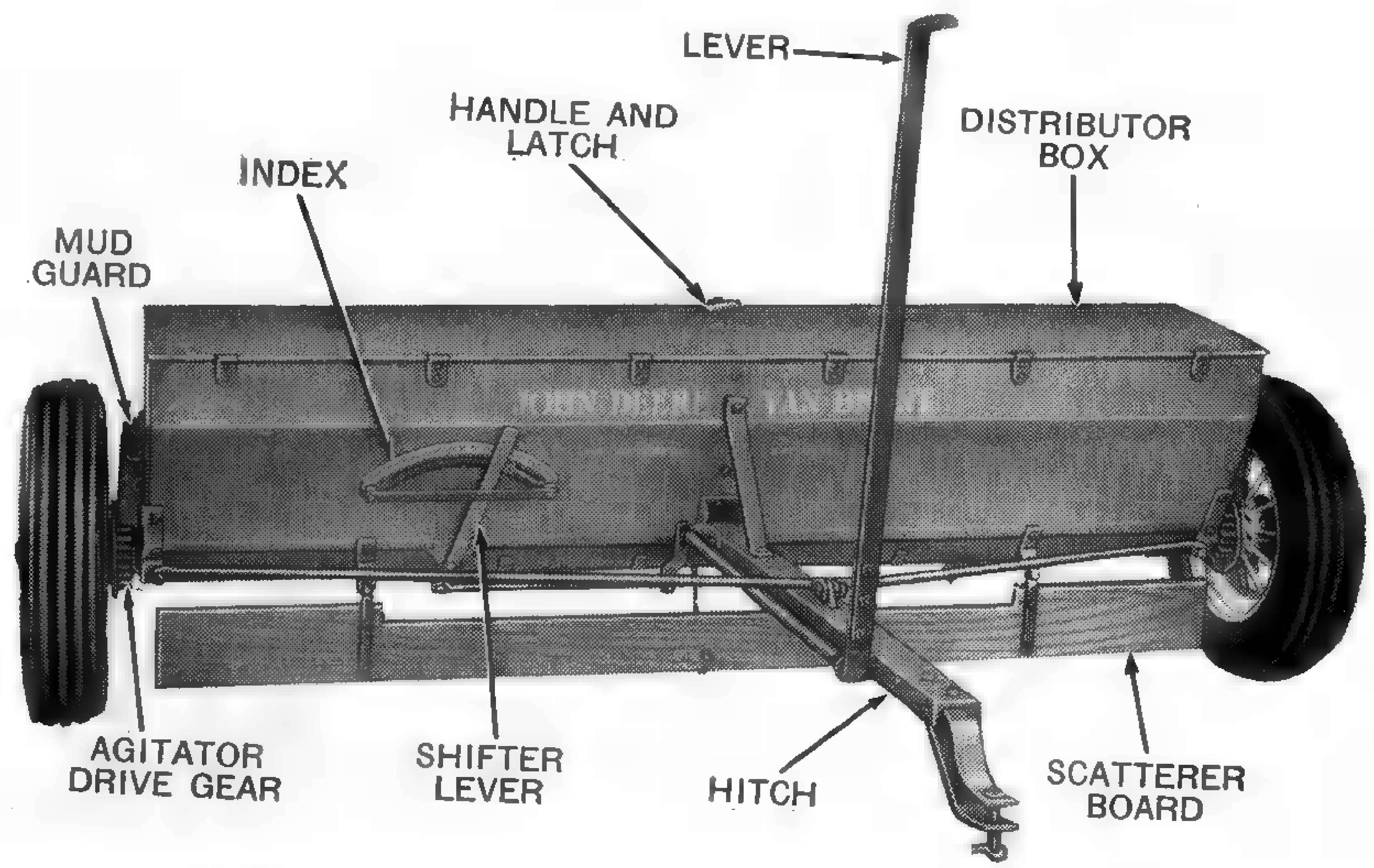


Figure 215—The modern lime and fertilizer distributor.

Spreads Evenly. Uniform spreading of the correct amount of material per acre is the first requisite of a good lime sower. Bunching or skipping brings unsatisfactory results.

Fig. 215 shows a lime and fertilizer sower which spreads lime or fertilizer evenly in any amount from 200 to 20,000 pounds per acre. The operator's only responsibilities are filling the hopper, setting his machine to sow the desired amount per acre, and driving the team or tractor. Two levers on the rear of the hopper (see Fig. 216) provide adjustment for quantity to be distributed. Half the feeds may be shut off when sowing a narrow strip.

Agitator Keeps Material Flowing. A revolving agitator in the bottom of the hopper keeps the lime or fertilizer flowing evenly through the feed openings. Its purpose is to prevent clogging or bridging of the material and the consequent skipping that would result.

Scattering boards, hung beneath the feed openings, aid in even distribution. The material is deflected and spread as

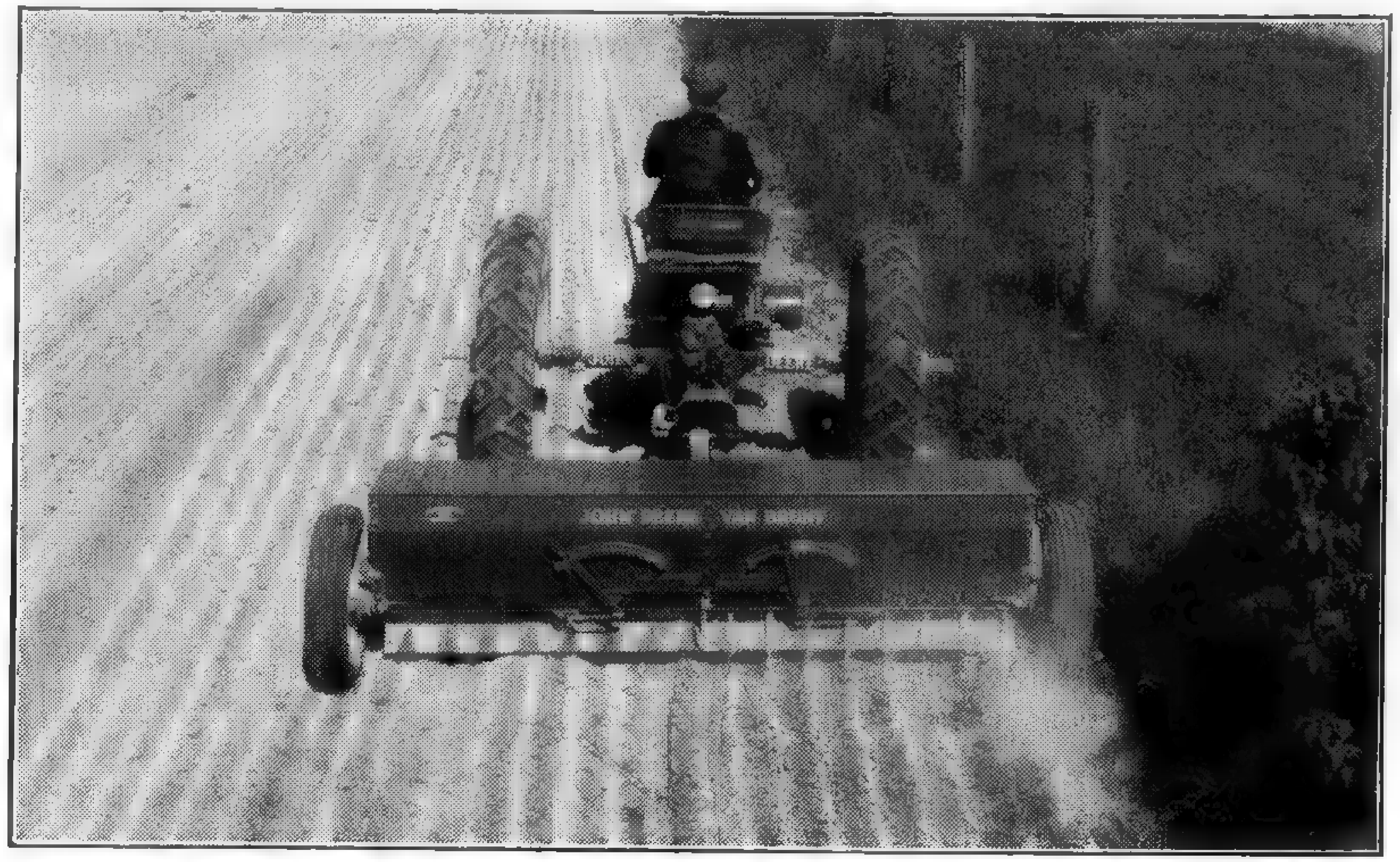


Figure 216—Spreading a uniform layer of lime with a modern lime and fertilizer distributor. Half the feeds have been closed to finish the job.

it falls from the feeds. These boards also aid in more even distribution on windy days. Adjustment up or down is provided by a chain on each board.

If properly cared for, a lime sower should last for many years and prove to be a profitable investment.

In addition to the fertilizer distributors described above, a simple lime-spreading attachment for spreading lime in practically any quantity desired, is available for many modern manure spreaders, thereby making the manure spreader doubly useful in preserving soil fertility.

Questions

1. *What are the advantages of using a lime or fertilizer sower? Discuss methods of sowing.*
2. *Why is even distribution important?*
3. *What is the purpose of the agitator?*
4. *Why is a scattering board used?*
5. *Are lime and fertilizer sowers used in your community?*

Chapter XXII.

SPECIALIZED EQUIPMENT

In some sections of the country, there are farming conditions and soil conditions that demand entirely different techniques of farming and the use of specialized implements which, oftentimes, are unfamiliar to the general farmer.

For example, in those areas where irrigation is practiced, level fields are essential for practical and economical use of valuable water. As a result, landshaping implements of various types were developed to meet this particular need.

In some areas, the growing of many diversified crops showed the farmer's need for low-cost equipment which would handle many farm jobs. This problem brought about the tool-bar system of farming.

In other sections, deep, thick layers of hardpan or plowpan prevented valuable moisture from seeping into the soil. This condition led to the development of the deep-

Figure 217—The land leveler can be used for smoothing fields or making borders.

tillage method of farming which has proved so practical in areas where these hardpan conditions exist.

Land Leveler. The land leveler, landshaper, and landplane, as the various types of leveling tools are called, were developed originally for use in irrigated sections of the country to level fields or orchards for proper use of water. Their use has extended to the ricefields and to sections where terracing, contouring, and other soil conservation methods are practiced, wherever water distribution or control is a problem.

By leveling fields to be irrigated, less water is required; the control of water is far easier, far less work. There are no spots in the field which are left high and dry; there are no low spots to become waterlogged and loaded with alkali. Harvests, too, are easier because crops mature more uniformly and ripen at the same time.

On fields where rough leveling and border making are to be done, the land leveler of the type shown in Fig. 217 is used. This type of leveler can also be used as a bottomless

Figure 218—The integral tool carrier with pickup disk harrow.

scraper for building ponds, leveling roadways, etc. Where it is necessary to shave the field surface so that it is "table-top smooth," the landplane or landshaper should be used. The latter implement has a greater bridging effect and enables the operator to level the field completely.

Servicing the land leveler (see Fig. 217) is very simple. The implement is built ruggedly to handle the work of earth moving; there are few wearing parts. The cutting blade has two edges which can be reversed when one side is worn. The blade can be sharpened easily if it becomes dulled or nicked.

The only regular servicing required is the infrequent lubrication of moving parts as suggested in the operator's manual furnished by the manufacturer. Naturally, proper inflation of the rubber tires will prolong the life of the tires.

Tool-Bar Farming. The growing of diversified crops made it necessary for farmers to purchase many implements to handle all their different farming operations. Changing market demands and the necessity of changing from one

Figure 219—The heavy-duty tool carrier with stiff standards which penetrate 16 inches deep.

crop to another brought about the development of the implement carrier, equipped with a tool bar which is capable of handling a wide variety of economical implement-attachments.

This implement makes it possible for farmers to save considerably on their implement investment by avoiding the duplication of complete machines (wheels, controls, frames, etc.). Instead, if the farm job requires listers, the farmer simply purchases the lister bottoms and standards and attaches them to the standard tool bar. Any implement-attachment—furrowers, chisels, coil-spring cultivators, panbreakers, ditchers, border disks, vineyard plows, transplanters, corrugators, and many other attachments which can be attached to a standard square tool bar—can be used efficiently with a tool carrier. Thus, the farmer has a practical and economical answer to his problem.

Tool-bar farming lends itself well to integral operation with many types of tractors. The tool carrier, shown in Fig. 220, is typical of those used with larger general-purpose

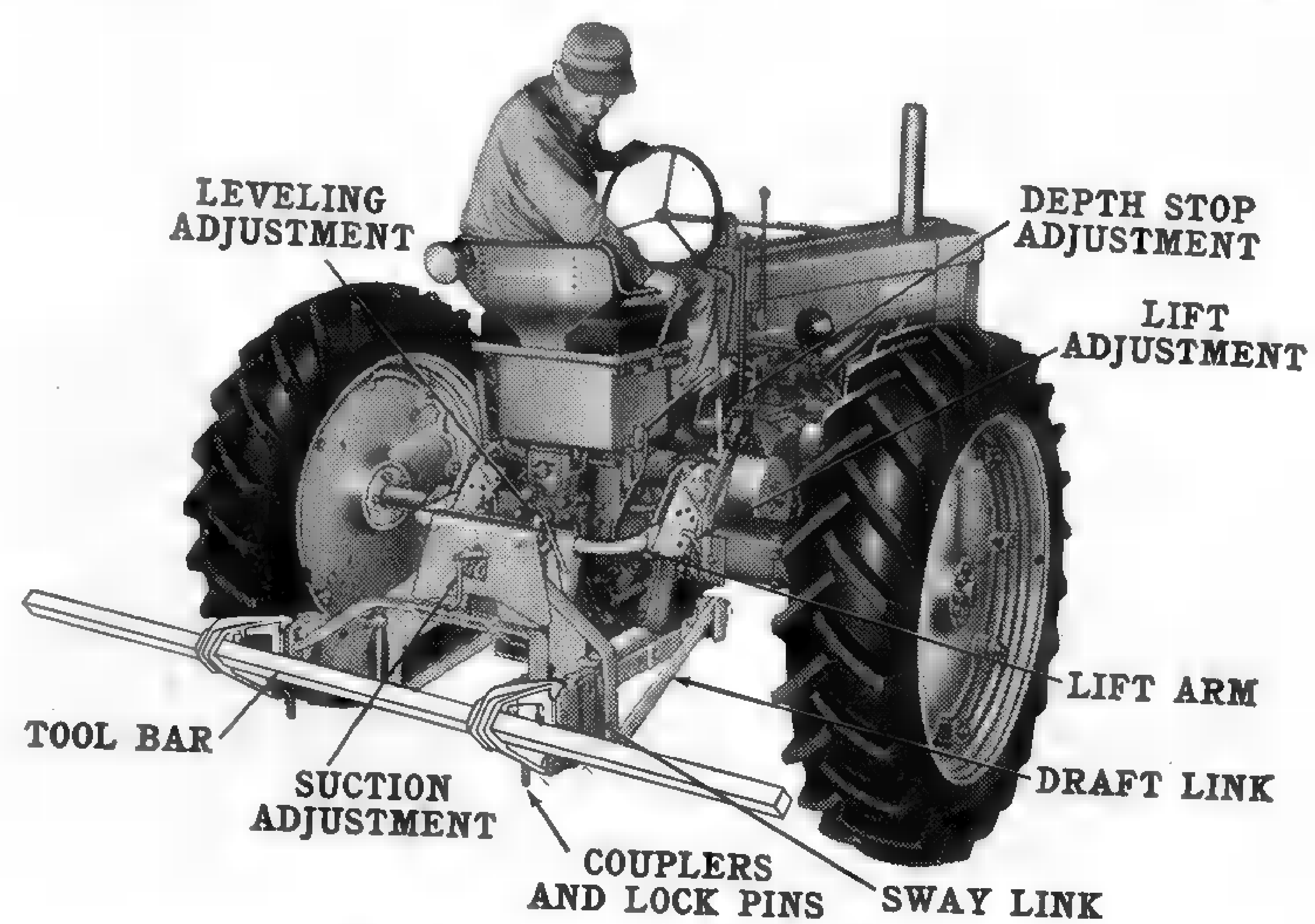


Figure 220—The integral tool carrier for general-purpose tractors.

tractors; some track-type tractors can be equipped with tool carriers to handle a wide variety of jobs. (See Fig. 222.)

Two important factors are essential to the profitable use of an integral tool carrier. *First:* There are many jobs the tractor must handle on the farm and, therefore, the tractor should not be tied up with an integral carrier that is bundlesome, inconvenient, and difficult to remove. The carrier should be quickly and easily attached or detached to the tractor. *Second:* The working tools also should

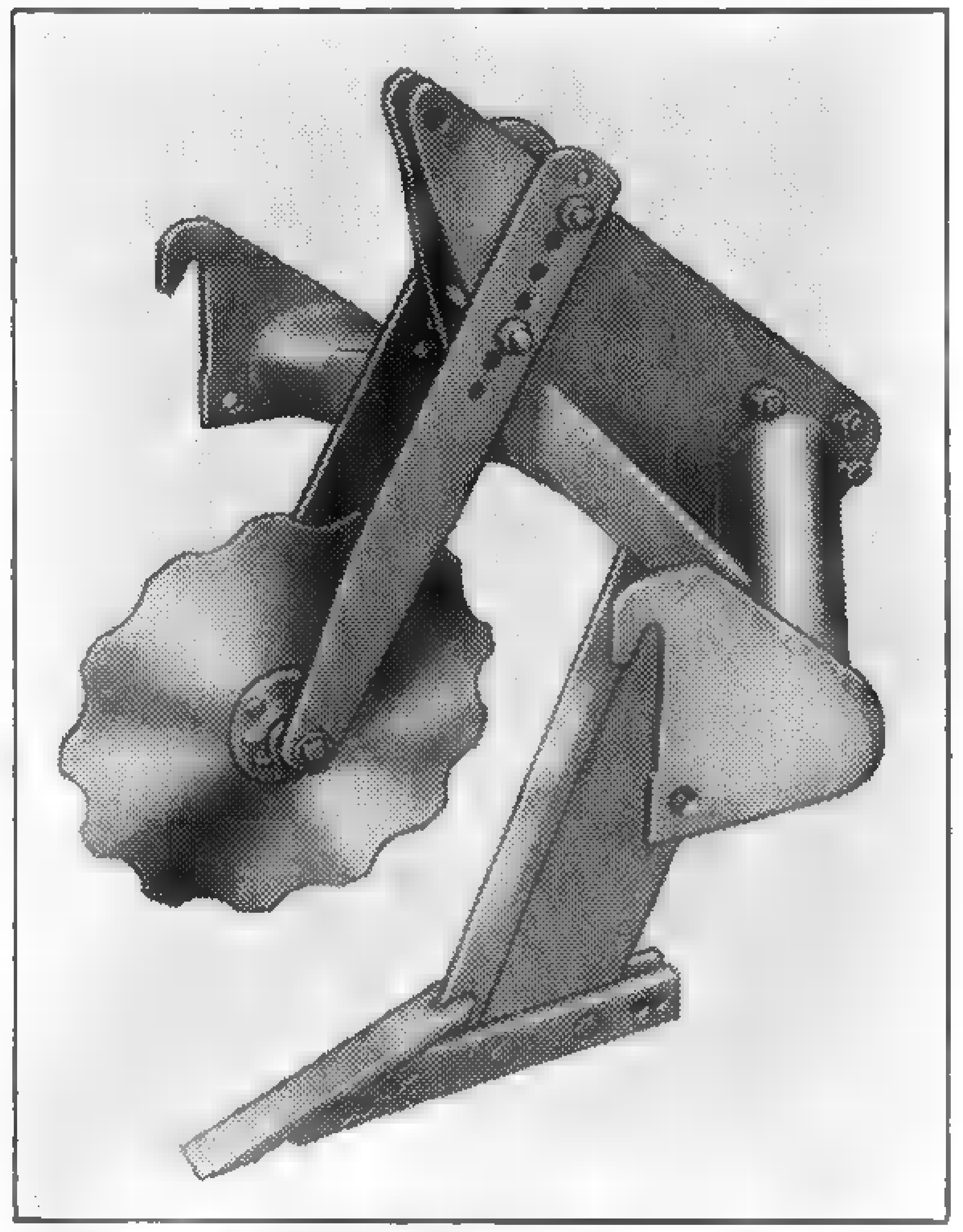


Figure 221—Panbreaker attachment for tool carrier.

Figure 222—The bulldozer is just one of the many implements which can be used with this integral tool carrier for the small track-type tractor.

be easy to remove or attach so that the operator uses a minimum of time and effort in changing from one tool to another.

The carrier, shown in Fig. 220, connects directly to the tractor at four points, at each end of the rockshaft and at both sides of the drawbar. Convenient slip pins connect the carrier at each of these points. The implement-attachments are attached rigidly to a tool bar. The coupler hooks, in the case of this particular carrier, are locked by slip pins, as shown.

The close-coupled design of the integral carrier enables the operator to maneuver in a minimum of space. This is an important advantage when working along ditches, fences, and trees or when backing into tight corners. Most tool carriers are widely adjustable for a variety of field and soil conditions.

There's little servicing required with a tool carrier. The only lubrication required on the carrier shown in Fig. 220 is at the grease fitting at the top of the yoke.

Drawn-type carriers, as shown in Fig. 223, have been simplified in design. They have a minimum of wearing parts and have been designed for manual rope control or for use with hydraulic power, as the farmer desires. Either steel wheels or rubber tires are generally available.

Since the greatest advantage of a tool carrier is the wide versatility, the quick attaching and detaching of implement-attachments is of prime importance. Several types of attaching devices are used. On the carrier shown in Fig. 223, eyebolt clamps are used. On loosening the bolts, the clamp and cap swing down and away from the tool bar, enabling the operator to remove the tool bar (with implement attached), quickly and easily. The replacement tool, mounted upon a similar bar, can be locked in with equal ease. Implement-attachments can be spaced on the tool bar as required for the particular farming operation. Since the

carrier is used on a variety of jobs where row spacings may vary, it is essential that the drawn carrier have a variable wheel tread which can be conveniently adjusted.

Servicing the drawn carrier in Fig. 223 is a simple job. Lubrication of the various axle points, hitch, and wheels, as directed by the operator's manual, is all that is required. Rubber tires, of course, should be properly inflated for long wear. Adjusting parts should be oiled as directed.

Deep-Tillage Farming. In many parts of the country, fields are infested with hardpan or plowpan which prevents rain from soaking deep into the soil. As a result, there is excessive water run-off; then, in dry seasons, there is no moisture in the subsoil for the plants to draw upon.

By shattering this tight subsoil layer with a panbreaker or subsoiler, the ground is broken up. Water penetrates where it falls; soil soaks up the valuable moisture and creates a moisture reservoir in the subsoil for plant roots to draw

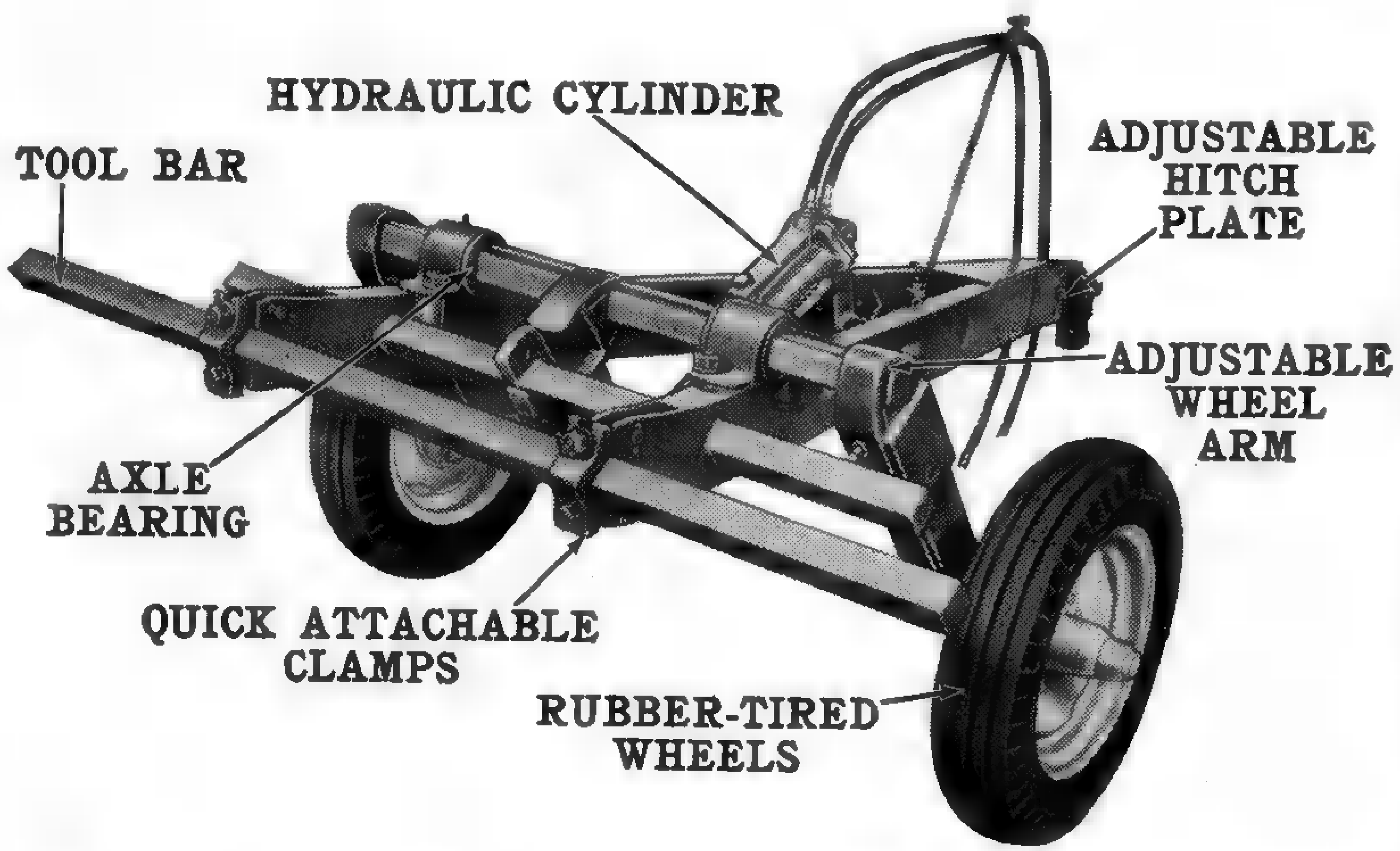


Figure 223—The drawn tool carrier can be equipped to handle a wide variety of tillage jobs.

upon during dry weather. Many farmers who have practiced this method of farming have experienced increased crop yields. However, other benefits include the holding of the water where it belongs, reducing erosion, and keeping the valuable topsoil at home.

Panbreakers or subsoilers (see Fig. 224) work at depths from 10 to 36 or more inches deep, depending on the size used. The digging standard is long and narrow with a heavy wedge-like point. The tip of this point works just below the subsoil formation, lifting and shattering the brittle hardpan ahead and to either side as the panbreaker moves forward. Thus, the subsoil layer is thoroughly broken with a minimum of power. Best results are obtained by working the soil during the driest season when the subsoil is dry and brittle.

The same implement, equipped with a "mole-ball" (see Fig. 225), can be used in low, soggy land where field drainage is a problem. The mole-ball, a torpedo-shaped steel

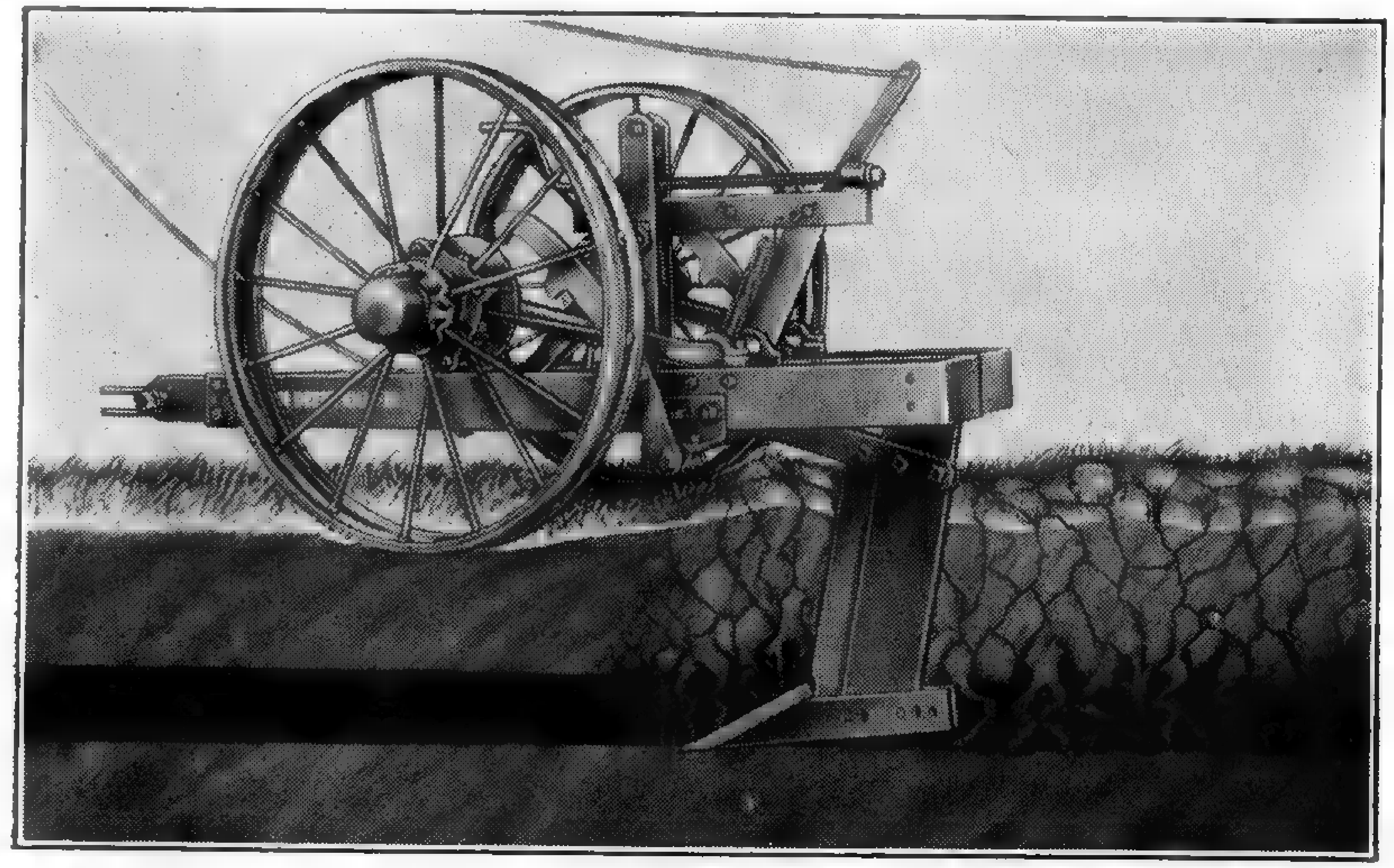


Figure 224—This cross-sectional drawing shows how the point of the panbreaker lifts and shatters the layer of hard, dry plowpan. Notice how it keeps the fertile topsoil on top.

ball, is pulled through the ground at the desired working depth, forcing the soil aside with tremendous pressure and opening a tunnel through which the water can pass. The soil is well broken above to aid seepage of excess water into the tunnel. This operation permits early tillage after spring thaws and rains, helps warm up the soil, reduces soil-washing, improves soil aeration, and prevents drowning out of valuable crops.

Operation of the panbreaker or subsoiler is a simple operation. The implement shown in Fig. 224 is rope-controlled from the tractor seat. A pull on one rope engages the lifting hook with the lifting rack on the wheel. As the panbreaker moves forward, the standard rises out of the ground. A pull on the other rope permits the panbreaker to lower to the set working position. A threaded adjusting crank at the top of the implement accurately regulates and maintains the working depth. The panbreaker can be set to

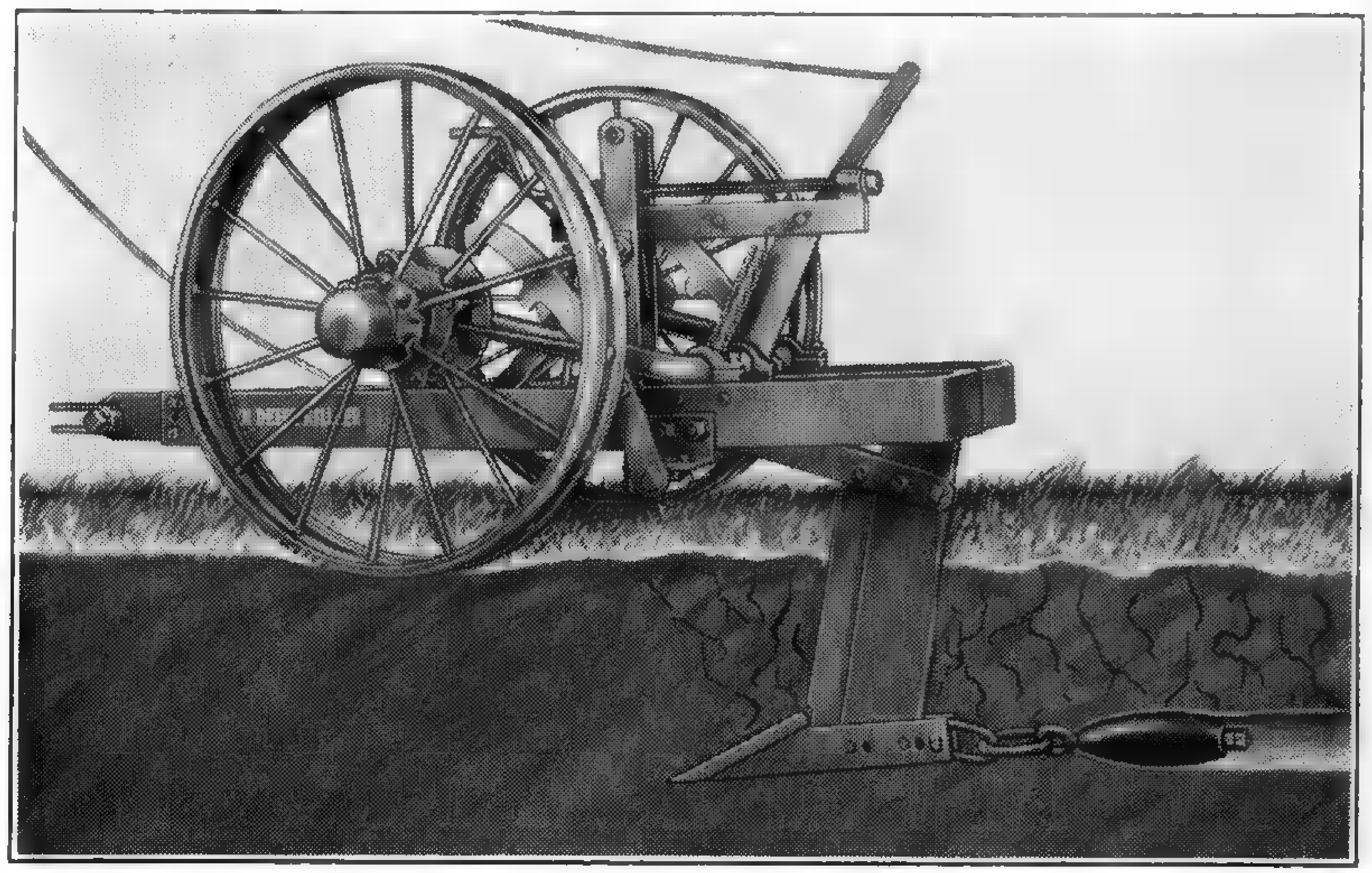


Figure 225—This cross-sectional drawing shows how the panbreaker, with the mole-ball attachment, forces the soil aside to form a tunnel for field drainage.

work at any depth to its maximum limit, depending on the size of the panbreaker used.

Axle sleeves can be replaced in the wheels, if necessary. The shin and point of the panbreaker standard can also be replaced if worn. Other than these two items, there is seldom any servicing required on a panbreaker except lubrication of moving parts.

Questions

1. *Is land leveling a practical farm operation in your community? If so, how could a land leveler be used on your farm?*
2. *What is the difference between the land leveler and the landplane or shaper?*
3. *Would it be advantageous to consider the use of tool-bar farming in your community? What types of tool carriers are available?*
4. *Name some of the types of farming operations which can be accomplished with a tool carrier and equipment.*
5. *Is hardpan or plowpan a problem in your community? If so, what are the advantages to be obtained from using a panbreaker?*
6. *In what conditions is the "mole-ball" used?*

USEFUL INFORMATION

Decimal Parts of an Inch

1/64—.015625
1/32—.03125

3/64—.046875
1/16—.0625

5/64—.078125
3/32—.09375

7/64—.109375
1/8—.125

9/64—.140625
5/32—.15625

11/64—.171875
3/16—.1875

13/64—.203125
7/32—.21875

15/64—.234375
1/4—.250

17/64—.265625
9/32—.28125

19/64—.296875
5/16—.3125

21/64—.328125
11/32—.34375

23/64—.359375
3/8—.375

25/64—.390625
13/32—.40625

27/64—.421875
7/16—.4375

29/64—.453125
15/32—.46875

31/64—.484375
1/2—.500

33/64—.515625
17/32—.53125

35/64—.546875
9/16—.5625

37/64—.578125
19/32—.59375

39/64—.609375
5/8—.625

41/64—.640625
21/32—.65625

43/64— .671875
11/16— .6875

45/64— .703125
23/32— .71875

47/64— .734375
3/4— .750

49/64— .765625
25/32— .78125

51/64— .796875
13/16— .8125

53/64— .828125
27/32— .84375

55/64— .859375
7/8— .875

57/64— .890625
29/32— .90625

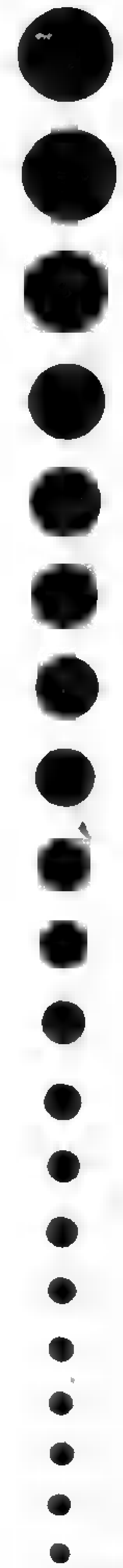
59/64— .921875
15/16— .9375

61/64— .953125
31/32— .96875

63/64— .984375
1—1.00000

USEFUL INFORMATION

Sizes of Wire



A. S. & W. STEEL WIRE GAUGE	SIZES OF WIRE		Weight One Mile Pounds	Pounds per Foot	Feet to Pound
	Common Fractions	Decimally			
1		.2830	1128.0	.2136	4.681
	9/32	.28125	1114.0	.211	
2		.2625	970.4	.1838	5.441
	1/4	.250	880.2	.1667	
3		.2437	836.4	.1584	6.313
4		.2253	714.8	.1354	7.386
	7/32	.21875	673.9	.1276	
5		.2070	603.4	.1143	8.750
[illegible]		.1920	519.2	.0983	10.17
	3/16	.1875	495.1	.0937	
7		.1770	441.2	.0835	11.97
8		.1620	369.6	.070	14.29
	5/32	.15625	343.8	.0651	
[illegible]		.1483	309.7	.0586	17.05
10		.1350	256.7	.0486	20.57
	1/8	.1250	220.0	.0416	
11		.1205	204.5	.0387	25.82
12		.1055	156.7	.0296	33.69
	3/32	.09375	123.8	.0234	
13		.0915	117.9	.0223	44.78
14		.0800	90.13	.0170	58.58
15		.0720	73.01	.0138	72.32
16	1/16	.0625	55.0	.0104	95.98
17		.0540	41.07	.0077	128.6
18		.0475	31.77	.006	166.2
19		.0410	23.67	.0044	223.0
20		.0348	17.05	.0032	309.6

Miles Traveled in Plowing an Acre

Width of Furrow, Inches	Miles
10	9-9/10
11	9
12	8-1/4
13	7-1/2
14	7
15	6-1/2
16	6-1/6

Acreage per Mile of Various Widths

Width	Acres	Width	Acres
1 foot	0.121	15 feet	1.815
5 feet	0.605	16 feet	1.936
8 feet	0.968	18 feet	2.178
10 feet	1.21	20 feet	2.42
12 feet	1.452	24 feet	2.904
14 feet	1.694	25 feet	3.025

Miles Traveled in Planting an Acre—3′6″ Rows

1-Row Planter	2.34 miles
2-Row Planter	1.17 miles
3-Row Planter	.78 miles

Acres Planted in Traveling One Mile—3′6″ Rows

1-Row Planter	.42 acres
2-Row Planter	.84 acres
3-Row Planter	1.26 acres

There are 10,667 stalks in an acre planted in 3′6″ rows, three stalks to the hill, hills 3′6″ apart, or drilled one stalk every 14 inches.

There are 3,556 hills in an acre planted in 3′6″ rows, hills 3′6″ apart.

U. S. Government Land Measure

A township—36 sections, each a mile square.

A section—640 acres.

A quarter section—half a mile square, 160 acres.

An eighth section, half a mile long, north and south, and a quarter of a mile wide—80 acres.

A sixteenth section, a quarter of a mile square—40 acres.

The sections are all numbered 1 to 36, commencing at the northeast corner.

The sections are divided into quarters, which are named by the cardinal points. The quarters are divided in the same way. The description of a forty-acre lot would read: The south half of the west half of the southwest quarter of section 1 in township 24, north of range 7 west, or as the case might be, and sometimes will fall short and sometimes overrun the number of acres it is supposed to contain.

NOTE—In most of the Western states, where all the land was laid out by the Government, all titles, except in city lots, are passed by description, as under the Government survey, and there a square of 6 miles, or 36 square miles, is one township.

Land Measure

To find the number of acres in a body of land, multiply the length by the width (in rods) and divide the product by 160. When the opposite sides are unequal, add them, and take half the sum for the mean length or width.

To Measure Corn in Cribs

Ear corn of good quality, measured when settled, will hold out at $2\frac{1}{2}$ cubic feet to the bushel. Allowance should be made for snapped corn, corn that is poorly husked, or otherwise inferior in quality, which will hold out at more than $2\frac{1}{2}$ cubic feet per bushel.

Rule—At $2\frac{1}{2}$ cubic feet to the bushel, divide the cubic feet in crib by $2\frac{1}{2}$, or multiply by 2 and divide by 5.

To Find the Number of Tons of Hay in a Mow

Multiply the length by the width by the height (all in feet) and divide by 400 to 500 depending on the kind of hay and how long it has been in the mow.

To Find the Number of Tons of Hay in a Stack

Multiply the overthrow (the distance from the ground on one side over the top of the stack to the ground on the other side) by the length by the width (all in feet); multiply by 3; divide by 10, and then divide by 500 to 600, depending upon the length of time the hay has been in the stack.

Capacity of Corn Cribs. (Dry Corn)

(Height, 10 Feet)

Length	$\frac{1}{2}$	1	12	14	16	18	20	22	24	28	32	36	48	64
Width 6	12	24	288	366	384	432	480	528	576	672	768	864	1152	1536
$6\frac{1}{4}$	12	25	300	350	400	450	500	550	600	700	800	900	1200	1599
$6\frac{1}{2}$	13	26	312	364	416	468	520	572	624	728	832	936	1248	1664
$6\frac{3}{4}$	13	27	324	378	432	486	540	594	648	756	864	972	1296	1728
7	14	28	336	392	448	504	560	616	672	784	896	1008	1344	1792
$7\frac{1}{4}$	14	29	348	406	464	522	580	638	696	812	928	1044	1392	1856
$7\frac{1}{2}$	15	30	360	420	480	540	600	660	720	840	960	1080	1440	1920
$7\frac{3}{4}$	15	31	372	434	496	558	620	682	744	868	992	1116	1488	1984
8	16	32	384	448	512	576	640	704	768	896	1024	1152	1536	2048
$8\frac{1}{2}$	17	34	408	476	544	612	680	748	816	952	1088	1224	1632	2176
9	18	36	432	504	576	648	720	792	864	1008	1152	1296	1728	2304
10	20	40	480	560	640	720	800	880	960	1120	1280	1440	1920	2560

The length is found in top line, the width in left-hand column—the height being taken at 10 ft. Thus, a crib 24 ft. long, $7\frac{1}{2}$ ft. wide and 10 ft. high, will hold 720 bushels of ear corn, reckoning $2\frac{1}{2}$ cubic feet to hold a bushel. If not 10 ft. high, multiply by the given height and cut off right-hand figure. If above crib were only 7 ft. high, it would hold 720 x 7, equals 504(0) bu., etc. The same space will hold twice as much grain as ear corn. Thus, a crib that holds 720 bushels of ear corn will hold 720 x 2 equals 1440 bushels of grain.

Capacity of Silo

A silo, properly filled—that is, if the contents are made compact throughout—contains one ton of silage for every 50 cubic feet of space. To illustrate the economy of a silo to store stock feed as compared with a barn, a ton of hay requires 400 cubic feet of space. A farmer can easily figure how much a silo will contain by the following rules:

Multiply the square of the diameter by 0.7854, which will be the area of the circular floor. Multiply the area of the floor by the height, which will give the number of cubic feet. One cubic foot of silage weighs 40 lbs. Multiply the cubic feet by 40, and the result is the number of pounds of silage the silo will contain. Divide that by 2,000 to find the number of tons.

Diameter	Depth	Capacity in Tons	Acres to Fill 15 Tons to Acre	Cows It Will Keep 6 Months, 40 Lbs. per Day
10	20	31	2-1/3	8
12	20	45	3	12
12	24	54	3-3/5	15
12	28	63	4-1/5	17
14	22	67	4-1/2	18
14	24	74	5	20
14	28	87	5-2/3	24
14	30	93	6	26
16	24	96	6-2/5	27
16	26	104	7	29
16	30	120	8	33
18	30	152	10-1/5	42
18	36	183	12-1/3	50

Cistern Capacity

A cistern ten feet in diameter and nine feet deep will hold 168 barrels.

A cistern five feet in diameter will hold five and two-thirds barrels for every foot in depth.

A cistern six feet in diameter will hold six and three-fourths barrels for every foot in depth.

A cistern eight feet in diameter will hold nearly twelve barrels for every foot in depth.

A cistern nine feet in diameter will hold fifteen and one-half barrels for every foot in depth.

A cistern ten feet in diameter will hold eighteen and three-eighths barrels for every foot in depth.

To Find the Contents of Square Tanks in Gallons

Rule—Multiply the area of the bottom by the height in order to secure the cubic feet. Multiply the cubic feet by $7\frac{1}{2}$ (exact 7.48) and the result will be the number of gallons. For the contents, in barrels, multiply the cubic feet by .2375.

To Find the Value of Articles Sold by the Ton

Multiply the number of pounds by the price per ton, point off 3 places and divide by 2.

To Find the Contents of Barrels and Casks in Gallons

Rule—Multiply the square of the mean diameter (in inches) by the depth (in inches) and the product by .0034.

Circles and Globes

To find the circumference of a circle, multiply the diameter by 3.1416.

To find the area of a circle, multiply the square of the diameter by .7854.

To find the surface of a globe, multiply the square of the diameter by 3.1416.

To find the solidity of a globe, multiply the cube of the diameter by .5236.

Commodity Weights and Measures

A pint's a pound—or very nearly—of the following: Water, wheat, butter, sugar, blackberries.

A gallon of milk weighs 8.6 pounds; cream, 8.4 pounds; $46\frac{1}{2}$ quarts of milk weigh 100 pounds.

A keg of nails weighs 100 pounds. A barrel of flour weighs 196 pounds; of salt, 280 pounds; of beef, fish or pork, 200 pounds; cement (4 bags) 376 pounds.

Cotton in a standard bale weighs 480 pounds. A bushel of coal weighs 80 pounds.

A barrel of cement contains 3.8 cubic feet; of oil 42 gallons.

A barrel of dry commodities contains 7.056 cubic inches or 105 dry quarts.

A bushel, leveled, contains 2,150.42 cubic inches; a bushel heaped—2,747.7 cubic inches. (Used to measure apples, potatoes, shelled corn in bin.)

A peck contains 537.605 cubic inches. A dry quart contains 67.201 cubic inches.

A board foot= 144 cubic inches; a cord contains 128 cubic feet.

Weights and Volumes of Water

One cubic inch of water weighs .036 pounds. One cubic foot weighs 62.5 pounds.

One cubic foot = 7.48 gallons. One pint (liquid) weighs 1.04 pounds. One gallon weighs 8.355 pounds. One gallon = 231 cubic inches. One liquid quart = 57.75 cubic inches.

Tables Convenient for Taking Inside Dimensions

A box 24 x 24 x 14.7 inches will hold a barrel of $31\frac{1}{2}$ gallons.
A box 15 x 14 x 11 inches will hold 10 gallons.
A box $8\frac{1}{4}$ x 7 x 4 inches will hold a gallon.
A box 4 x 4 x 3.6 inches will hold a quart.
A box 16 x 12 x 11.2 inches will hold a bushel.
A box 12 x 11.2 x 8 inches will hold a half-bushel.
A box 7 x 6.4 x 12 inches will hold a peck.
A box 8.4 x 8 x 4 inches will hold a peck, or four dry quarts.
A box 6 x 5.6 x 4 inches deep will hold a half-gallon.

To Find Height of Tree or Building

Set up a stick and measure its shadow. Measure length of shadow of tree. Length of shadow of tree, times height of stick, divided by length of shadow of stick equals height of tree.

Common Measures

Long Measure

12	Inches	1 Foot
3	Feet	1 Yard
5½	Yards	1 Rod
320	Rods	1 Mile
1	Mile	5280 Feet

The following are also used:

1 Size.................1/3-Inch
(Used by Shoemakers)

1 Hand................4 Inches
(Used in measuring the height of horses)

1 Fathom...............6 Feet
(Used in measuring depths at sea)

Square Measure

144	Square Ins.	1 Square Ft.
9	Square Ft.	1 Square Yd.
30¼	Square Yds.	1 Square Rd.
160	Square Rods	1 Acre
640	Acres	1 Square M.

(An acre is equal to a square whose sides are 208.71 feet)

Surveyor's Square Measure

10,000 Square Links.1 Sq. Chain
10 Square Chains....1 Acre
10 Chains Square....10 Acres

Surveyor's Linear Measure

7.92 Inches.............1 Link
100 Links...............1 Chain
80 Chains..............1 Mile
(Gunter's Chain is the unit and is 66 feet long)

Dry Measure

2 Pints.................1 Quart
8 Quarts...............1 Peck
4 Pecks................1 Bushel
1 Bushel contains 2150.42 cubic inches or approximately 1¼ cubic feet

Liquid Measure

4 Gills.................1 Pint
2 Pints.................1 Quart
4 Quarts...............1 Gallon
1 Gallon contains 231 cubic inches.
1 Cubic Ft. equals 7½ gallons.

Cubic Measure

1728 Cubic Inches...1 Cubic Ft.
27 Cubic Feet....1 Cubic Yd.
128 Cubic Feet....1 Cord

Number of Pounds to the Bushel

Alfalfa	60
Barley	48
Beans (White)	60
Bran	20
Buckwheat	48
Blue Grass Seed	14
Clover Seed	60
Clover (Sweet)	60
Corn (Shelled)	56
Corn (In Ear)	70
Coal, Hard	80
Hubam Seed	60
Hungarian Grass Seed	45
Kafir Corn	56
Lime	80
Malt	38
Millet Seed, Common	50
Oats	32
Onions	57
Orchard Grass	14
Peas	60
Potatoes	60
Red Top Seed	14
Rye	56
Timothy Seed	45
Wheat	60

Belting Pointers

How to Find Length Required

When it is not convenient to measure with the tapeline the length required, apply the following rule: Add the diameter of the two pulleys together, divide the result by 2, and multiply the quotient by 3-1/4; then add this product to twice the distance between the centers of the shafts, and you have the length required.

If possible to avoid it, connected shafts should never be placed one directly over the other, as in such case the belt must be kept very tight to do the work.

It is desirable that the angle of the belt with the floor should not exceed 45 degrees. It is also desirable to locate the shafting and machinery so that belts should run from each shaft in opposite directions, as this arrangement will relieve the bearings from the friction that would result when the belts all pull one way on the shaft.

To Find the Belt Speed in Feet per Minute

Multiply diameter of pulley (in inches) by 3.1416. This gives circumference of pulley and this result multiplied by number of revolutions will give you belt speed in inches.

Relative Transmission of Horsepower for Any Given Width of Belt

The horsepower for a given speed will be directly proportioned to the width of the belt; that is, a 4-ply, 16 inches wide, running at a certain speed, will transmit eight times as much power as a 4-ply belt, 2 inches wide, running at the same speed; and a belt 100 inches wide, ten times as much as a 10-inch belt of the same thickness, running at the same speed, etc.

To Find the Horsepower That Any Given Belt Will Transmit Economically

Multiply the width of the belt in inches by its speed in feet and divide the result by 800. The final result will be the horsepower for a 4-ply belt. For a 6-ply belt, divide this result by 600; for an 8-ply, divide by 400; for a 10-ply, divide by 350.

To Find the Ply of a Belt of a Given Width Required

To transmit a given horsepower economically, at a given belt speed, multiply the given horsepower by 800 and the given width in inches by the given belt speed in feet and divide the first result by the second.

If the final result is one, or nearly one, a 4-ply belt is required; if one and one-half, a 6-ply; if one and three-quarters to two, an 8-ply; if two to two and one-quarter, a 10-ply.

USEFUL INFORMATION

To Find Width of Belt Required

To find the width of a 4-ply belt required to transmit a given horsepower at a given belt speed per minute: Multiply the given horsepower by 800, and divide the result by the given belt speed.

To find the width of a 6-ply belt required: Multiply horsepower by 600; divide result by belt speed.

To find the width of an 8-ply belt required: Multiply horsepower by 400; divide result by belt speed.

To find the width of a 10-ply belt required: Multiply horsepower by 350; divide result by belt speed.

To Find Speed and Diameter of Pulleys

The product of the diameter and speed of the driving pulley equals the product of the diameter and speed of the driven pulley; consequently, if the speed and the diameter of the driving pulley are given, multiply them together and divide by the diameter of the driven pulley to find the speed of the driven; or divide by the speed of the driven pulley to find its diameter.

Example—The drive pulley on a tractor is $9\frac{1}{2}$ inches in diameter and runs at 1,000 rpm; what size pulley must be used on a thresher cylinder shaft that must run 1,100 rpm?

$9\frac{1}{2}$ times 1,000 equals 9,500; divided by 1,100, equals 8.64. Since pulleys are made only in certain standard diameters, use either the next size larger, 9-inch diameter, and raise the engine speed slightly, or use $8\frac{1}{2}$-inch pulley, considering that the slight slippage will reduce the effective speed to the correct number of revolutions per minute.

Example—At what speed will a rock crusher run, if its 6-inch pulley is belted to a $9\frac{1}{2}$-inch pulley on a tractor with a rpm of 1,000?

$9\frac{1}{2}$ times 1,000 equals 9,500; divided by 6, equals 1,583 rpm.

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